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Multi-Area Field Sampling Plan

12th Street Landfill Site (Operable Unit No. 4), Kalamazoo River (Operable Unit No. 5), and Plainwell Mill Site (Operable Unit No. 7)

Allied Paper, Inc./Portage Creek/
Kalamazoo River Superfund Site
Allegan County, Michigan

Revision 04
November 2008

Submitted in connection with Phase 2 of Addendum No. 1 (Test Pits) and the Plainwell Mill RI/FS Work Plan (Phase 1 Initial Groundwater Assessment)

Prepared by RMT, Inc.
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Acronyms and Abbreviations

µg/L	micrograms per liter
µg/kg	micrograms per kilogram
AA	atomic absorption
ARAR	Applicable, or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
BFB	p-bromofluorobenzene
BNA	base-neutral-acid extractable
CCB	continuing calibration blank
CCC	calibration check compound
CCV	continuing calibration verification
CD	Consent Decree
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	Chain-of-Custody
COPC	constituent of potential concern
CVAA	cold vapor atomic absorption
DFTPP	decafluorotriphenylphosphine
DI	deionized
DO	dissolved oxygen
DQI	data quality indicators
DQO	Data Quality Objective
ECD	electron capture detector
EDD	electronic data deliverable
Eh	redox
FB	field blank
FS	Feasibility Study
FSP	Field Sampling Plan
GC/MS	gas chromatograph/mass spectrophotometer
HSP	Health and Safety Plan

ICB	initial calibration blank
ICP	inductively coupled plasma
ICPMS	inductively coupled plasma mass spectroscopy
ICS	interface check samples
ICV	initial calibration verification
IDW	investigation-derived waste
kg	kilogram
KRSG	Kalamazoo River Study Group
L	liter
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LRA	linear range analysis
MDEQ	Michigan Department of Environmental Quality
MDL	Method Detection Limit
MS	matrix spike
MS/MSD	matrix spike/matrix spike duplicate
MSD	matrix spike duplicate
NCP	National Contingency Plan
NIST	National Institute of Standards and Technology
NTU	nephelometric turbidity unit
OSC	On-Scene Coordinator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pH	negative logarithm (base 10) of hydrogen ion activity
PID	photoionization detector
PQO	Project Quality Objective
POTW	publicly-owned treatment works
PM	Project Manager
QA	quality assurance
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
QC	quality control
QL	Quantitation Limit

RAS	routine analytical services
RD/RA	Remedial Design/Remedial Action
RF	response factor
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPD	relative percent difference
RL	reporting limit
RPM	Remedial Project Manager
RSD	relative standard deviation
RT	retention time
SAP	Sampling and Analysis Plan
SAS	special analytical services
SOP	standard operating procedure
SOW	Statement of Work
SPCC	system performance check compound
SRI/FS	Supplemental Remedial Investigation/Feasibility Study
SRM	standard reference material
SW846	Test Methods for Evaluating Solid Waste, 1996
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time-Critical Removal Action
TEMP	temperature
TB	trip blank
TSS	Total suspended solids
U.S. EPA	United States Environmental Protection Agency
VOC	volatile organic compound
WATS	Weyerhaeuser Analytical Testing Services

Section 1
Introduction

1.1 Background

Weyerhaeuser Company (Weyerhaeuser) was identified as a Potentially Responsible Party (PRP) for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site (Site) in a General Notice letter dated April 8, 2004, that was received by Weyerhaeuser and two other PRPs. Concurrently, Weyerhaeuser was negotiating a Consent Decree (CD) to undertake specific activities on the former Plainwell Mill and 12th Street Landfill sites. On February 22, 2005, Weyerhaeuser entered into a CD with the United States Environmental Protection Agency (U.S. EPA) for the Design and Implementation of Certain Response Activities at the 12th Street Landfill site (Operable Unit No. 4) and the Plainwell Mill site (Operable Unit No. 7). Both sites are part of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site (Figure 1-1), which is located in southwestern Michigan. A Statement of Work (SOW) for the Remedial Design/Remedial Action (RD/RA) at the 12th Street Landfill site was attached to the CD. A SOW for the Remedial Investigation/Feasibility Study (RI/FS) at the Plainwell Mill site was subsequently issued by the U.S. EPA, with an effective date of August 17, 2006.

The U.S. EPA requires that all parties involved in environmental monitoring and measurement efforts mandated or supported by the U.S. EPA participate in a centrally managed quality assurance program. Any party generating data under this program has the responsibility to implement minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of the data are known and documented. To ensure that the responsibility is met uniformly, a written Quality Assurance Project Plan (QAPP) and associated Field Sampling Plan (FSP) must be prepared for each project. A Multi-Area QAPP for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site has been submitted for review under separate cover. It has been prepared to support field activities by describing specific protocols that will be followed for sampling, sample handling and storage, chain-of-custody procedures, and laboratory analysis for multiple areas of the Site. The Multi-Area QAPP also defines objectives, organization, functional activities, and specific quality assurance (QA) and quality control (QC) activities associated with implementing the following activities:

1. Emergency Response in the former powerhouse discharge channel at the 12th Street Landfill
2. Emergency Response of portions of the riverbank along the Plainwell Mill
3. Predesign investigations for the remedial design for the 12th Street Landfill
4. Phase 2 of Addendum No. 1 Plainwell Mill Investigations
5. Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment
6. Remedial Action for the 12th Street Landfill

QAPP amendments will be submitted to supplement the current QAPP as additional work activities are authorized and defined.

This associated Multi-Area FSP establishes sample collection and field monitoring methods and procedures to be followed to ensure that sampling and investigatory activities at the Site are conducted in a consistent manner and in accordance with technically acceptable protocols. The objective of the FSP is to facilitate the collection of environmental monitoring data that meet Data Quality Objectives (DQOs) established in the Multi-Area QAPP (RMT, 2008a). This FSP will be modified in the future as other sampling programs are developed for Operable Unit Nos. 4 and 7, as well as other areas of the site, as appropriate.

1.2 Document Organization

This FSP was prepared to establish Standard Operating Procedures (SOPs) for environmental monitoring activities expected or likely to be conducted for purposes of completing activities associated with the following activities:

1. Emergency Response in the former powerhouse discharge channel at the 12th Street Landfill
2. Emergency Response of portions of the riverbank along the Plainwell Mill
3. Predesign investigations for the remedial design for the 12th Street Landfill
4. Remedial Action for the 12th Street Landfill
5. Phase 2 of Addendum No. 1 Plainwell Mill Investigations
6. Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment

Additional SOPs will be submitted as work areas are added or work tasks are modified. SOPs developed as components of amended scope documents will become common to all sampling activities of the same type (*e.g.,* sediment core collection).

As additional work plans are prepared, it is anticipated that they will be incorporated as additional addenda to this document, referencing a combination of the same SOPs, amended SOPs, or additional SOPs. If additional SOPs are required, they will be added to Attachment A. If modified SOPs are required, they will replace existing SOPs in this document. Specific addenda will be provided as standalone documents.

1.3 Project Setting

The 12th Street Landfill and Plainwell Mill sites are located in Allegan County, Michigan (Figure 1-2). The 12th Street Landfill is located in Otsego Township (Section 24, Township 1N, Range 12W), and the Plainwell Mill is located in the City of Plainwell (Section 30, Township 1N, Range 11W). Both sites are located adjacent to the Kalamazoo River, with the 12th Street Landfill located approximately 1½ miles northwest and downstream of the Plainwell Mill site. The 12th Street Landfill site is composed of approximately 6.5 acres and is situated on roughly a 24-acre property that is bordered to the east by woodlands and a former hydroelectric powerhouse discharge channel on the Kalamazoo River, to the north and west by wetlands, to the south and southwest by an asphalt plant, and to the south and southeast by industrially developed lands and the Plainwell Dam (which is scheduled to be removed as part of the U.S. EPA-approved TCRA in 2007-2008). The Plainwell Mill site covers approximately 36 acres and is bordered by the Kalamazoo River to the north (to the top of the riverbank, as defined in the CD), the Plainwell central business district to the east, residential properties to the south, and commercial properties and the City of Plainwell wastewater treatment plant to the west.

Weyerhaeuser recently took ownership of the 12th Street Landfill property from Plainwell, Inc., a bankrupt entity with no ongoing business operations. The City of Plainwell is the current owner of the Plainwell Mill property, having purchased the mill site out of the Plainwell bankruptcy in 2006. The Mill property has been vacant since the former Simpson Plainwell Paper Company filed for bankruptcy in 2000. Weyerhaeuser owned and operated the Mill for an approximate 9-year period, between 1961 and 1970. During that period, dewatered sludge from wastewater treatment operations was excavated from lagoons on the Mill property and transported for disposal at the 12th Street Landfill site.

1.4 Applicability of the FSP

This FSP is applicable for work performed by Weyerhaeuser under its 2005 CD with the U.S. EPA and for other specified work in areas to be determined. The FSP addresses specific projects at operable units at the Site, as well as other projects as may be specified later. The applicable operable units are as follows:

- Operable Unit No. 4 – 12th Street Landfill site
- Operable Unit No. 5 – Kalamazoo River
- Operable Unit No. 7 – Plainwell Mill site

The organization and specific QA/QC activities associated with the various data collection activities are presented in the Multi-Area QAPP, which was submitted under separate cover.

This FSP has been developed in general accordance with the U.S. EPA's document entitled, "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA," dated October 1988.

1.5 Scope and Description of Revision Process

This FSP provides guidance for the various fieldwork activities by defining the sampling and data-gathering methods to be used. The scope of the document is outlined as follows:

- Section 1 provides the introduction, purpose, and scope of the FSP.

- Section 2 describes a summary of the sampling program, including sample locations and frequency.
- Section 3 covers the logistics of sample designation and field records.
- Section 4 summarizes the sample handling and analysis procedures to be followed. Details regarding the sample analytical procedures are discussed in the QAPP.
- Section 5 describes field physical measurements.
- Section 6 describes the management of investigation-derived waste.

As new projects are initiated, new information will be added to this Multi-Area FSP to cover the new project and additional revisions will made, as needed. A new revision number will also be assigned to the document (*e.g.,* Revision 02 will be revised to Revision 03, and so on). Specifically, the following additions/revisions will be made:

- **Summary of Sampling Program –** A subsection will be added to Section 2, to provide a summary of the sampling program. In addition, a new table will be added in Section 2 to provide a summary of the sample types and locations for the new project. The subsections and tables in the previous version of Section 2, which describe previous projects conducted under this Multi-Area FSP, will not be revised or deleted.
- **Other Text Sections –** New information will be added to other sections of the Multi-Area FSP, as necessary to cover the new activities. Information pertaining to previous projects will not be revised or deleted.
- **Standard Operating Procedures (Attachment A) –** If the previously developed SOPs, which are included in Attachment A of the Multi-Area FSP, do not cover the sampling procedures that will be utilized for the new project, new SOPs will be added to Attachment A, as necessary. The SOPs that were included for previous projects will not be deleted. SOP revisions will only be made if necessary to update standard sampling procedures or protocols, and if revised, the revision number and date (located in the upper right-hand corner) will be modified as appropriate.
- **Example Forms/Logs (Attachment B) –** If the previously developed sampling forms, which are included in Attachment B of the Multi-Area FSP, do not include forms that will be utilized for the project, new sampling forms will be added to Attachment B, as necessary.

Section 2
Summary of Sampling Program

2.1 Overview

Environmental sampling for the various activities associated with OU-4, OU-5, and OU-7 will include sampling of various media to meet a range of information needs. These information needs will vary depending upon the specific tasks being conducted. At a minimum, this Multi-Area FSP will be used to support the following work activities:

- Operable Unit No. 4 – Emergency response activities in the former powerhouse discharge channel and RD/RA activities in connection with the 12th Street Landfill, as defined in the CD and SOW
- Operable Unit No. 5 – Emergency response activities on portions of the riverbank along the Plainwell Mill
- Operable Unit No. 7 – RI/FS and RD/RA activities in connection with the Plainwell Mill, as defined in the CD and SOW

The subsections below provide a summary of the sample types and locations for each project conducted under this Multi-Area FSP to date, as well as new projects being added in this revision. These projects include the following (note: as described in Subsection 1.5 of this Multi-Area FSP, the summaries of projects included in previous revisions of this document have not been revised or deleted):

1. Emergency response activities in the former powerhouse discharge channel at the 12th Street Landfill (as initially described in Revision 00, June 2007).
2. Emergency response activities on portions of the riverbank along the Plainwell Mill (as initially described in Revision 01, September 2007).
3. Predesign investigations for the remedial design for the 12th Street Landfill (as initially described in Revision 02, April 2008).
4. Phase 2 of Addendum No. 1 Plainwell Mill Investigation [Revision 03, September 2008]).
5. Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment (added in this version of the Multi-Area FSP [Revision 04, November 2008]).
6. Remedial Action for the 12th Street Landfill (added in this version of the Multi-Area FSP [Revision 04, November 2008]).

The subsections below also reference Standard Operating Procedures (SOPs; Attachment A), and example forms and logs (Attachment B). To date, a total of fifteen SOPs have been prepared to describe applicable sampling procedures and protocols (SOPs F-1 through F-15; see Attachment A). New SOPs, forms, logs, and QAPP worksheets, which are developed as part of future work plan submittals, will be included in later revisions of this Multi-Area FSP, as described in Subsection 1.5.

2.2 OU-4: Emergency Response – Former Powerhouse Discharge Channel Sampling and Monitoring Activities

In late February 2007, the U.S. EPA authorized a Time-Critical Removal Action (TCRA) to remove polychlorinated biphenyl (PCB)-contaminated sediment in the former Plainwell Impoundment (a section of Operable Unit No. 5 of the Allied Paper/Portage Creek/Kalamazoo River Superfund site). This work was subsequently implemented through an administrative settlement agreement and Order on Consent for Removal Action (V-W-07-C-8-63). As part of the TCRA, the earthen section of the Plainwell Dam will be removed and the Kalamazoo River will be rerouted through the former powerhouse channel. The 12th Street Landfill abuts the river and is located directly downstream of the earthen section of the Plainwell Dam. The Plainwell Mill also abuts the Kalamazoo River and PCB-containing materials have been documented along the river bank at the Mill. The change in the Kalamazoo River channel will result in an increased river gradient and higher velocities upstream and along the rerouted channel (USGS, 2004 and USDA, 2004). The modified river flow is expected to mobilize residuals currently present in the powerhouse channel downstream and to erode bank material in the area of the Mill. Thus, the TCRA scope of activities are actions or occurrences which threaten releases of waste material (as defined in the CD) from both the 12th Street Landfill and the Plainwell Mill property. Since any such release may present an immediate threat to public health or welfare of the environment, Weyerhaeuser has been authorized to conduct several emergency response actions in conjunction with completing the required work under the CD.

The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories:

- Surface water sampling and field measurements
- Surface water and flow measurement
- Water treatment system sampling
- Sediment sampling
- Soil sampling using direct push equipment

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.2.1 Sample Collection Procedures

Water Monitoring and Field Measurements

Surface water monitoring and field measurements will be performed during the emergency action activities to meet various objectives including:

- Measurement of surface water PCB and total suspended solids (TSS) concentrations in river water.
- Measurement of potentially transported PCBs and suspended sediments in river water.
- Monitoring of trends in surface water PCB concentrations over time.
- Monitoring of the relative effects of removal activities on turbidity and PCBs in the main river water column outside the channel during the removal actions.
- Monitoring of turbidity of infiltrating groundwater to establish discharge location.
- Evaluation of water quality associated with the water treatment system.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for surface water data collection are provided in appendices to this document that can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

Surface Water and Field Measurement Procedures (SOP F-1). This SOP will be used for the collection of a water column sample for laboratory analysis and can be applied to grab samples, vertically integrated samples, bottle sampling, or sampling using a specific device, such as an ISCO automated sampler or peristaltic pump. This SOP will be used for most samples collected from the river for PCB and TSS analysis. It can also be used for the collection of grab samples from an open channel, the end of a pipe, or from anywhere within a water treatment stream. This SOP includes the use of standard hand-held metering devices and should be used to collect field measurements of surface water quality parameters including turbidity, temperature, dissolved oxygen (DO), and conductivity.

Surface Water Flow Measurement Procedures (SOP F-2). This SOP will be used to measure flow in the river by measuring cross-sectional area and velocities across the channel at the point of measurement.

Water Treatment System Monitoring Procedures (SOP F-3). This SOP describes the field procedures for collection of in-field water treatment system measurements including grab samples for PCB analysis at the effluent of the water treatment system, grab samples for TSS at the effluent of the water treatment system, and grab samples for phosphorus at the effluent of the water treatment system.

Sediment Sampling

Sediment sampling will be performed during the OU-4 Emergency Response activities to meet various objectives, including:

- Identify the distribution and physical characteristics of sediments.
- Characterize the nature and extent of PCBs in sediments present in the Former Powerhouse Channel.
- Monitor the effects of removal activities and determine post-removal PCB concentrations in sediment.

To support these objectives, sediment samples will be collected as intact cores to provide samples at depth, or as surficial grab samples to characterize the sediment at the top of the sediment bed. Core samples will be collected using polycarbonate tubing unless other methods are identified by the area-specific work plan or FSP addendum. Surface grab samples will be collected using sediment core methods or using a petit Ponar dredge. SOPs for sediment collection methods are provided in:

> *Sediment Sampling Procedures* (SOP F-4). This SOP provides field procedures for the collection of sediment samples, sediment cores, and probing for bathymetric surveys.

Geotechnical Soil Sampling

The purpose of the geotechnical investigation is to determine the extent, height and width, and materials used in the berm along the Kalamazoo River so that a slope stability evaluation can be completed. The location of the berm will be used to assess potential adverse affects to the stability of the fill material that may occur as a result of cutting back existing material along the riverfront. Visual observation of the materials used in the construction of the berm will be used to approximate the physical characteristics of the material, which will be used in the stability model. Together, the location and the physical characteristics of the berm will be used to model the stability of the landfill, provide data to help assess whether or not the vegetation present along the river can be preserved, and ultimately to provide inputs to the design of a stable final slope.

> *Soil Sampling Procedures with Direct Push Equipment* (SOP F-5). This SOP provides field procedures for the collection of soil samples utilizing a direct push sampler.

2.2.2 Sample Locations

Specific sample locations depend upon both the types of samples being collected and field conditions. Many sample locations will be established based in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP and this FSP. Available information by sample type is summarized in Table 2-1.

2.3 OU-5: Emergency Response – Plainwell Mill Banks

In a letter dated June 29, 2007, the U.S. EPA has authorized Weyerhaeuser Company, under Paragraph 67 of their 2005 Consent Decree, to take actions to prevent, abate, or minimize a release or potential release of hazardous substances from the former Plainwell Mill banks (part of the Kalamazoo River Operable Unit [OU-5]).

The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories.

- Surface water sampling and field measurements
- Surface water and flow measurement
- Water treatment system sampling
- Sediment sampling
- Surficial soil sampling

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.3.1 Sample Collection Procedures

Water Monitoring and Field Measurements

Surface water monitoring and field measurements will be performed during the Plainwell Mill Banks Emergency Action activities to meet various objectives including:

- Measurement of surface water PCB and TSS concentrations in river water.
- Measurement of potentially transported PCBs and suspended sediments in river water.
- Monitoring of trends in surface water PCB concentrations over the duration of the construction activities.
- Monitoring of the relative effects of removal activities on turbidity and PCBs in river water column adjacent to the banks during the residual removal actions.
- Evaluation of water quality associated with the water treatment system.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for surface water data collection are provided in appendices to this document that can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

> *Surface Water and Field Measurement Procedures* (SOP F-1). This SOP will be used for the collection of a water column sample for laboratory analysis and can be applied to grab samples, vertically integrated samples, bottle sampling, or sampling using a specific device, such as an ISCO automated sampler or peristaltic pump. This SOP will be used for most samples collected from the river for PCB and TSS analysis. It can also be used for the collection of grab samples from an open channel, the end of a pipe, or from anywhere within a water treatment stream. This SOP includes the use of standard hand-held metering devices and should be used to collect field measurements of surface water quality parameters including turbidity, temperature, DO, and conductivity.
>
> *Surface Water Flow Measurement Procedures* (SOP F-2). This SOP will be used to measure flow in the river by measuring cross-sectional area and velocities across the channel at the point of measurement.
>
> *Water Treatment System Monitoring Procedures* (SOP F-3). This SOP describes the field procedures for collection of in-field water treatment system measurements including grab samples for PCB analysis at the effluent of the water treatment system, grab samples for TSS at the effluent of the water treatment system, and grab samples for phosphorus at the effluent of the water treatment system.

Sediment Sampling

Sediment sampling will be performed during the Plainwell Mill Banks Emergency Action activities to meet various objectives, including:

- Identify the distribution and physical characteristics of bank sediments.
- Characterize the nature and extent of PCBs in sediments present along the Plainwell Mill Banks.
- Monitor the effects of removal activities and determine post-removal PCB concentrations in near-bank sediment.

To support these objectives, sediment samples will be collected as intact cores to provide samples at depth, or as surficial grab samples to characterize the sediment at the top of the sediment bed. Core samples will be collected using polycarbonate tubing unless other methods are identified by the area-specific work plan or FSP addendum. Surface grab samples will be collected using sediment core methods or using a petite Ponar dredge. SOPs for sediment collection methods are provided in:

Sediment Sampling Procedures (SOP F-4). This SOP provides field procedures for the collection of sediment samples and cores.

Post Construction Soil Confirmation Sampling

The purpose of the post construction soil confirmation sampling is to evaluate the success of the residual removal activities in the Plainwell Mill bank along the Kalamazoo River. A geotechnical evaluation may be required in order to evaluate slope stability. The need for this evaluation will be confirmed in the field during removal activities.

Surficial Soil Sampling Procedures (SOP F-6). This SOP provides field procedures for the collection of soil confirmation samples utilizing stainless steel scoops.

2.3.2 Sample Locations

Specific sample locations depend upon both the types of samples being collected and field conditions. Many sample locations will be established based in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP and this FSP. Available information by sample type is summarized in Table 2-2. Additional details regarding the sampling program are included in Table 3-1 of the Design Report.

2.4 OU-4: Predesign Investigations – Remedial Design for the 12th Street Landfill

Operable Unit No. 4 (OU-4) of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site consists of the closed 12th Street Landfill and four areas outside the landfill where PCB-contaminated residual material has been observed. The 24-acre parcel includes the 6.5-acre landfill and approximately 17 acres of wetlands to the north/northwest of the landfill. Additional portions of OU-4 include the woodland area owned by the State of Michigan (State) under management of the Michigan Department of Natural Resources (MDNR), the asphalt plant operation adjacent to the landfill, and the former powerhouse discharge channel, which are located outside the landfill property line. Contamination in the former powerhouse discharge channel was addressed as part of Emergency Actions implemented in 2007.

The 12th Street Landfill accepted paper residuals from the former Plainwell Mill, located in Plainwell, Michigan, during the period from approximately 1955 to 1981. The landfill reportedly also accepted solid waste from the mill during part of its period of active operation. A number of investigations have been performed at the site. The investigations have confirmed the nature of the material in the landfill and have shown that paper residuals are present in certain areas outside of the landfill (*i.e.,* in the wetlands to the north/northwest, the asphalt plant property, and the State property). Some of the residuals/native soil beyond the toe of the landfill (*i.e.,* outside the footprint of the landfill) may contain PCBs at concentrations exceeding State of Michigan or Kalamazoo River Superfund Site-specific ecological risk-based criteria.

A Record of Decision (ROD) for OU-4 was issued on September 28, 2001. The major components of the selected remedy include the following: "(1) the excavation and relocation into the landfill of contaminated residuals currently in the woodland, wetlands, and adjacent property, and the residuals in the former powerhouse discharge channel that are contiguous with the eastern side of the landfill, followed by the construction of a containment system; (2) the excavation and relocation into the landfill of the east side of the landfill along the former powerhouse discharge channel to create a buffer zone sufficient to insure no hydraulic connection between the wastes within the landfill containment system and the Kalamazoo River or the former powerhouse discharge channel; (3) the restoration of areas excavated, cleared and grubbed, or otherwise affected by the remedial action; (4) the construction of a side wall containment system around the outside of the landfill; (5) the construction of a cover (cap) over the landfill; (6) the installation of an appropriate groundwater monitoring network and the performance of long-term groundwater monitoring; (7) the performance of short-term surface water monitoring; (8) the placement of deed restrictions; (9) the construction of a fence, permanent markers, and warning signs; (10) the investigation of the need for a leachate collection system and, if deemed necessary, the construction of a leachate collection system; and (11) the implementation of long-term maintenance and post-closure care."

In January 2005, Weyerhaeuser negotiated a CD with the U.S. EPA (Civil Action No. 1:05-CV0003) for the design and implementation of certain response actions at Operable Unit No. 4 and the Plainwell Inc., Mill. Specifically, the CD requires RD and RA activities for the 12th Street Landfill and RI/FS and RD/RA activities for the former Plainwell Mill (Operable Unit No. 7). This revision of the Multi-Area FSP has been prepared in fulfillment of the requirements for a RD Work Plan for the 12th Street Landfill that are contained in the CD and the SOW.

The RD Work Plan for the 12th Street Landfill includes a number of predesign investigations, some of which involve field data collection and visual observations. Field data collection activities will include visual information obtained by the advancement of test pits, visual information obtained by the advancement of Geoprobe® borings, and gas concentration measurements (methane, carbon dioxide, and oxygen) in certain existing monitoring wells and in the Geoprobe® borings advanced as part of the predesign investigation. Pressure will also be recorded in certain existing monitoring wells.

The field investigations will involve: 1) a refined estimate of the extent of visible paper residuals beyond the landfill footprint; 2) the collection of data to support the grading design for the landfill; and 3) the collection of data for use in the design of a landfill gas management system. SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.4.1 Sample Collection Procedures

Data for Grading Design

Additional data is required to better estimate the thickness of paper residuals along the property boundaries with 12th Street, the asphalt plant to the southwest, and with the State property to the southeast, in order to reduce uncertainties in designing the final cover grades, and to support discussions with the owners of these adjacent properties concerning access. The scope of the investigative work necessary to obtain these data is as follows:

- Advance approximately nine Geoprobe® borings into the 12th Street Landfill at select locations where fill material is believed to extend beyond the property boundary to the southwest and to the southeast. The borings will be advanced to approximately 5 feet into the native soil underlying the fill, or to refusal. Each borehole will be given a unique identification number.
- Advance a minimum of two soil borings near the southern end of the landfill to confirm the thickness of the fill in this area. Advance the borings approximately 5 feet into the native soil underlying the fill or to refusal. The locations of these borings may be adjusted in the field as necessary to avoid underground or aboveground utility lines. Additional borings may be installed to the north of the initial borings as may be deemed useful by Weyerhaeuser, in consultation with oversight agencies as needed, for purposes of designing the landfill cover (*e.g.,* if fill material is not encountered at a location where existing data indicates fill is present).
- Prepare a Soil Boring Log (refer to Attachment B for a sample log) for each borehole based on visual observation. Classify the materials encountered based on the procedures outlined in ASTM D2488. The logs will document the borehole identification number, the drilling dates and times, names of field personnel, soil descriptions, sample depths, and recovery. Retain a representative sample of each type of material encountered (no laboratory analyses are planned). As may be appropriate, photographs of the materials encountered or other pertinent observations will be documented. Photographs will be labeled to indicate the subject, location, date, name of photographer, and project identification number.
- The on-site geologist/engineer will prepare the Soil Boring Logs in the field. The logs will be reviewed by the senior engineer in the office. A field notebook will also be maintained by the on-site geologist/engineer to document other pertinent

field information. The senior engineer will review the field notebook for clarity and completeness in meeting the investigation objectives.

- Following completion of the borehole logs, abandon the boreholes by filling them with a bentonite grout.
- Dispose of the Geoprobe® samples in an area on-site that will be covered by the final cover and in a manner that will not result in erosion before the final cover is installed.
- Decontaminate the Geoprobe® equipment following completion of the work. Decontamination will be performed at a decontamination pad constructed on top of the landfill. Refer to Subsection 6.1.2 of this FSP for additional information regarding the construction of the decontamination pad.
- Decontamination of Geoprobe® equipment between borings is not necessary because new acrylic tubes will be used at each location to collect material for visual observation (samples are not being collected for laboratory analysis).
- Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).
- Survey the locations and ground surface elevations of the boreholes following completion. The accuracy of the survey will be ± 0.01 foot for the horizontal coordinates and ± 0.1 foot for the vertical elevations. The survey locations will be added to the boring logs.

A more detailed description of field procedures for soil sampling using direct push methods (*i.e.,* Geoprobe®) is provided in SOP F-5 (Attachment A). The decontamination procedures are described above.

Landfill Gas Evaluation

Based on experience at other landfills containing similar materials, a passive gas venting system may to be necessary to prevent potential off-site migration from the landfill and to protect the integrity of the landfill cover. Thus, a detailed design for a passive gas venting system will be prepared during the design phase for the 12th Street Landfill. The design for the gas venting system may include features that support a potential future educational nature park. The passive gas venting system will also be designed such that it could be retrofitted to an active gas system if deemed necessary during the operation, monitoring, and maintenance (OM&M) period for the landfill.

To assist in the design for the passive gas venting system, the following scope of field investigations will be performed:

- As accessible, measure the concentrations of methane, carbon dioxide, and oxygen in the existing groundwater monitoring wells at the 12th Street Landfill that are screened in the vadose zone (MW-6A, MW-7A, and MW-8A), and in the Geoprobe® boreholes used to estimate the depth of the paper residuals along the property boundaries.
- As accessible, measure the gauge pressure in the existing groundwater monitoring wells at the 12th Street Landfill that are screened in the vadose zone (MW-6A, MW-7A, and MW-8A).

A passive gas venting system can be designed without the above information. If these data cannot be readily obtained, additional efforts will not be employed to collect this information.

Field procedures for soil gas collection and sampling, and pressure measurements, are provided in SOP F-7 (Attachment A).

Extent and Depth of Residuals Outside the Landfill Footprint

Wetland Area to the North of the Landfill - The approximate areal extent of visible paper residuals beyond the toe of the landfill within the wetland has been defined through previous investigations. This delineation needs to be confirmed at limited locations as part of the predesign studies. In addition, constructibility issues associated with a high water table in the wetland and the degree of difficulty in distinguishing the visible paper residuals from the native soil also need to be evaluated. The scope of the investigative work recommended to provide this information is as follows:

- A backhoe will be used to excavate approximately three test pits in the wetland to the north of the landfill to confirm the approximate areal extent of visible paper residuals beyond the toe of the landfill, to evaluate potential constructibility issues associated with working in the wetland, and to assess the degree of difficulty in distinguishing the visible paper residuals from the native soil.
- The test pits are anticipated to be approximately 10 to 15 feet long (perpendicular to the edge of the landfill) and approximately 2 to 4 feet wide. The test pits will be excavated to a maximum depth of 3 feet if no paper residuals are apparent, or to the bottom of visually-identifiable residuals. The depth and lateral extent of residuals in each test pit will be documented in the field by preparing a Test Pit Log (refer to Attachment B for a sample log).
- If visible residuals are observed in the end of a test pit furthest from the landfill, the test pit may be extended further away from the landfill and/or an additional test pit (or more) may be excavated nearby in order to confirm the areal extent of the visible residuals contiguous with the landfill within the wetland. If an additional

test pit (or more) is needed, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.

- Equipment used to excavate the test pits will be decontaminated following completion of the work. Decontamination will be performed at a decontamination pad constructed on the top of the landfill. Refer to Subsection 6.1.2 of this FSP for additional information regarding the construction of the decontamination pad. Decontamination of equipment between test pits is not necessary because samples are not being collected for laboratory analysis. Clumps and loose material will be removed from the bucket of the excavating equipment using hand tools as needed to obtain good visual characterization of the material present in the test pits. The clumps and loose material will be placed in the test pits.
- Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on-site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).
- In the event that in-field conditions limit use of excavating equipment, other tools, such as hand augers or shovels, may be used instead. In such instances, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.

  In addition, Weyerhaeuser will conduct a kick-off meeting with the U.S. EPA and its field representative(s) at the outset of the predesign field investigation. During this meeting, the schedule for conducting the predesign field activities and the process for obtaining U.S. EPA approval of field modifications will be reviewed.

Asphalt Plant/State Properties - The areal extent of visible paper residuals on the asphalt plant property to the southwest and on the State property to the southeast need to be delineated and the depth of visible paper residuals needs to be estimated more accurately in order to support discussions with the owners of these adjacent properties concerning access for future removal activities. The scope of the investigative work recommended to provide this information for the asphalt plant/State properties is as follows:

- A backhoe will be used to excavate approximately three test pits on the asphalt plant property and approximately four test pits on the State property.
- The test pits are anticipated to be approximately 10 to 15 feet long (perpendicular to the edge of the landfill) and approximately 2 to 4 feet wide. The test pits will be excavated to a maximum depth of 3 feet if no paper residuals are apparent, or to the bottom of visually-identifiable residuals. The depth and lateral extent of residuals in each test pit will be documented in the field by preparing a Test Pit Log (refer to Attachment B for a sample log).

- If visible residuals are observed in the end of a test pit furthest from the landfill, the test pit may be extended further away from the landfill and/or an additional test pit (or more) may be excavated nearby in order to confirm the areal extent of the visible residuals contiguous with the landfill within the wetland. If an additional test pit (or more) is needed, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.
- Equipment used to excavate the test pits will be decontaminated following completion of the work. Decontamination will be performed at a decontamination pad constructed on the top of the landfill. Refer to Subsection 6.1.2 of this FSP for additional information regarding the construction of the decontamination pad. Decontamination of equipment between test pits is not necessary because samples are not being collected for laboratory analysis. Clumps and loose material will be removed from the bucket of the excavating equipment using hand tools as needed to obtain good visual characterization of the material present in the test pits. The clumps and loose material will be placed in the test pits.
- Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on-site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).
- In the event that in-field conditions limit the use of excavating equipment, other tools, such as hand augers or shovels, may be used instead. In such instances, the U.S. EPA project manager, or designated alternate, will be contacted to discuss the situation and to agree on a course of action.
- In addition, Weyerhaeuser will conduct a kick-off meeting with the U.S. EPA and its field representative(s) at the outset of the predesign field investigation. During this meeting, the schedule for conducting the predesign field activities and the process for obtaining U.S. EPA approval of field modifications will be reviewed.

2.4.2 Sample Locations

Specific sample locations depend upon the types of samples being collected and on the field conditions. Many sample locations will be established in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP, and this FSP. Available information by sample type is summarized in Table 2-3. Additional details regarding the field program are included in the RD Work Plan (RMT, 2008b).

2.5 OU-7: Phase 2 of Addendum No. 1 Plainwell Mill Investigations

In a letter to Weyerhaeuser dated February 19, 2008, the U.S. EPA requested additional work along the former Plainwell Mill banks was requested in response to discovery of elevated concentrations of PCBs and oily soil encountered along the Plainwell Mill banks during the separate Plainwell Mill Banks Emergency Response activities. On July 15, 2008, a Draft Phase 2 Addendum No. 1 to the Plainwell Mill Remedial Investigation/Feasibility Study Work Plan was prepared and provided to U.S. EPA for review. The U.S. EPA provided technical review comments on the Draft Phase 2 Addendum No. 1 in a letter dated July 31, 2008. Subsequently, Weyerhaeuser provided response to comments and a redlined version of the Work Plan Addendum in a letter dated August 8, 2008. This Multi-Area FSP Addendum provides information to update the Multi-Area FSP sample collection and field monitoring methods and procedures for the RI/FS activities at the former Plainwell Mill property.

The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories:

- Test Pit Sampling
- PID sampling

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.5.1 Sample Collection Procedures

Test Pit Investigation

Test pit investigation and sampling will be performed during the RI activities to meet various objectives including:

- To assess the validity of the preliminary site conceptual model.
- To identify the source of elevated PCBs.
- To identify the source of oil material impact soil observed during the emergency removal action activities.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for test pit sampling are provided in Attachment A of this document and can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

Test Pit Sampling Procedures (SOP F-8). This SOP will be used for the development of test pits and for collection of soil samples for laboratory analysis. This SOP will be used for test pit samples collected from the Plainwell Mill. It can also be used for the collection of additional test pit samples from other Operable Units, as necessary.

This SOP includes the use of standard techniques for excavating a test pit and collecting a sample from the excavated soil. Equipment decontamination procedures are also included. A separate SOP is included for the PID readings that will occur with test pit excavation.

Photoionization Detector(PID) Sampling (SOP F-9). This SOP will be used to screen soil samples in the field and establish a background for PID comparison. PID readings will be used as one of the criteria for identification of samples for additional analysis.

2.5.2 Sample Locations

Specific sample locations depend upon both the types of samples being collected and field conditions. Many sample locations will be established in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP, and this FSP. Available information by sample type is summarized in Table 2-1. Additional details regarding the sampling program are included in Tables 6 and 7 of the Phase 2 Addendum to the RI Work Plan.

2.6 OU-7: Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment

The Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment includes a collection of shallow groundwater samples to assess the possible presence of floating product and to quantify the concentrations of constituents in shallow groundwater that may have been contributed by suspected or known contamination present on site. The limited existing groundwater data, the generally permeable subsurface sands present along the Kalamazoo River, the site history, and the size and configuration of the Plainwell Mill property make a phased groundwater investigation especially useful for focusing future data collection activities needed to meet the overall objectives of the required RI/FS.

The following subsections describe sample collection procedures, sample handling methods, and other procedures pertaining to the following general sampling categories:

- Groundwater Sampling
- Staff Gage Installation

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration and maintenance of field instruments, as appropriate.

2.6.1 Sample Collection Procedures

Groundwater Assessment

Groundwater well installation and sampling will be performed during RI/FS – Phase I Groundwater Assessment activities to meet various objectives including:

- Determine direction of groundwater flow on the Plainwell Mill Site and relationship with the Kalamazoo River and Mill Race.
- Evaluate the relationship between the elevation of onsite fill and residuals materials and the groundwater table.
- Evaluate potential for groundwater impacts associated with historic site operations.
- Collect sufficient groundwater analytical data for comparison to MDEQ Part 201 Criteria.
- Evaluate groundwater analytical results and refine list of Potential Contaminants of Concern for future sample analysis.

Several data collection methods will be used to achieve these objectives, depending on the purpose and intent of the data, and the DQOs specified in the applicable area-specific work plan and FSP addendum. SOPs for groundwater activities are provided in Attachment A of this document and can be used together or separately as needed to satisfy the goals of data collection. Specific SOPs are provided for:

Groundwater Well Sampling (SOP F-11). This SOP will be used to collect groundwater samples in the field.

Staff Gage Installation (SOP F-10). This SOP will be used for installation and reading of staff gages elevations.

2.6.2 Sample Locations

Specific sample locations depend upon both the types of samples being collected and field conditions. Sample locations will be established based in the field based upon site-specific conditions that impact the ability to collect representative samples and the guidelines in the work plan, QAPP, and this FSP. Available information by sample type is summarized Table 2-5. Additional details regarding the sampling program will be included in the Phase I RI/FS - Groundwater Sampling Work Plan.

2.7 OU-4: Remedial Action for the 12th Street Landfill

As described in Section 2.4, the 12th Street Landfill is composed primarily of the 6.5-acre closed landfill and the four areas outside the landfill where PCB-contaminated residual material has been observed.

The landfill is situated with 17 acres of wetlands on an approximately 24-acre parcel. Additional portions of OU-4 that are located outside the landfill property include the woodland area owned by the State under the management of the MDNR, the asphalt plant operation adjacent to the landfill, and the former powerhouse discharge channel. Contamination in the former powerhouse discharge channel was addressed as part of the Emergency Actions implemented in 2007.

A ROD for OU-4 was issued on September 28, 2001 (see Section 2.4 for a description of the major components of the ROD). In January 2005, Weyerhaeuser negotiated a CD with the U.S. EPA (Civil Action No. 1:05-CV0003) for the design and implementation of certain response actions at OU-4 and the Plainwell, Inc., Mill. These actions include the RD and RA activities for the 12th Street Landfill. The addendum to the Multi-Area QAPP has been prepared in fulfillment of the requirements for the Design Report for the 12th Street Landfill, as described in the CD and the SOW.

The Design Report for the 12th Street Landfill (RMT, 2008) includes a number of data collection activities, some of which are short-term activities to be performed during implementation of the RA and some of which are long-term activities. Short-term monitoring activities include verification soil sampling, ambient air monitoring for fugitive dust and VOCs, and surface water monitoring. . Long-term monitoring activities include landfill gas monitoring and groundwater monitoring.

SOPs for each type of sampling activity are provided in Attachment A. These SOPs describe or reference ancillary procedures for equipment cleaning, field measurements, and calibration of field instruments, as appropriate.

2.7.1 Sample Collection Procedures

Verification Soil Sampling

Upon completion of the excavation activities on the MDNR's property and the asphalt plant property to remove paper residuals, samples of the native soil underlying the excavated paper residuals will be collected and analyzed to confirm the adequacy of the excavation activities. The scope of the verification soil sampling includes the following activities:

- Collect approximately nine soil samples in the excavation on the MDNR's property and approximately 13 samples in the excavation on the asphalt plant property. The soil samples will be collected from approximately 6 inches below the surfaces of the excavation base and sidewalls, and analyzed for PCBs, and for the asphalt plant property, for VOCs. At least one sample will be collected from each sidewall of an excavation. The samples will be collected using a stainless-steel scoop, as described in SOP F-6 (see Attachment A).
- Determine the actual number of soil samples using a systematic random sampling strategy, following the MDEQ's S^3TM guidance (see Section 6.1.2 of the Design

Report for a detailed discussion). The samples will be submitted to the laboratory for quick-turn analysis, so that the results can be reviewed and the adequacy of the excavation verified before restoring the excavated areas. As necessary, additional excavation, followed by sample collection and analysis, may be performed.

- Prepare samples collected for VOC analysis using the methanol preservation method, as described in MDEQ Procedure for Collection and Methanol Preservation Of Soil Samples for Volatile Organics May 1, 2000. (Attachment C)
- Collect QC samples, including one equipment rinsate blank and one field duplicate soil sample from each excavation (*i.e.,* one on the MDNR's property and one on the asphalt plant property). Submit the QC samples for analysis of the same parameters as the field samples.
- Prepare a Sample Log (refer to Attachment B for a sample log form) for each sample. Describe the soil samples in the field using the Unified Soil Classification System. The logs will document the sample identification number, the sampling dates and times, the names of field personnel, soil descriptions, and sample depths. As may be appropriate, photographs of the materials encountered or other pertinent observations will be documented. Photographs will be labeled to indicate the subject, location, date, name of photographer, and project identification number.
- Perform decontamination, and manage investigation-derived waste in accordance with Sections 6.1.4 and 6.2.5.

Ambient Air Monitoring for Fugitive Dust

During implementation of the RA, preventive measures will be used to control fugitive dust, including watering frequently traveled unpaved roads and soil, and working surfaces on an as-needed basis. In addition, real-time ambient particulate measurements will be conducted. The general scope of the fugitive dust monitoring includes the following activities:

- Conduct real-time ambient particulate measurements at locations that are downwind of activities that have the potential to create fugitive dust, including the following activities: construction equipment traveling over unpaved surfaces, the unloading of soil, grading activities, cover placement, and other construction activities, as determined by visual observation and best professional judgment.
- During these activities, collect real-time ambient particulate measurements at three to four locations on the landfill property line with an MIE, Inc., Miniram monitor or equivalent, three times each day (*i.e.,* a total of 9 to 12 measurements per day). Each measurement will be taken at a different downwind location, unless elevated readings are measured at a particular location. In this case, readings may be repeated at this location during the day. If applicable, locations in which visible dust is evident will be preferentially selected for monitoring.
- The measurements will be taken in accordance with the active air sampling procedure described in SOP F-12 (see Attachment A). A total of three values will be recorded each time a location is monitored, with the average of the three values being used for comparison with the standards.

Ambient Air Monitoring for VOCs

During implementation of the RA, ambient air monitoring will be performed for VOCs. The general scope of the ambient VOC monitoring includes the following activities:

- Collect VOC measurements with a photoionization detector (PID) during work at the landfill in which paper residuals will be exposed. The measurements will be taken in accordance with SOP F-9 (see Attachment A).

Surface Water Monitoring

As part of the RA, additional riprap will be placed north of the existing riprap for added protection. During the placement of the riprap, surface water monitoring using a turbidity meter will be performed. The general scope of the surface water monitoring will include the following activities:

- Collect surface water samples at two locations, including an upstream location and a downstream location, at the following times:
  - prior to placement of any equipment or materials in a work area;
  - every other hour during the installation of the riprap along the channels edge; and
  - whenever field conditions warrant additional samples.
- Collect turbidity measurements using a hand-held turbidity meter, as described in SOP-F14 (see Attachment A).
- If the turbidity reading at the downstream location is greater than two times the result for the upstream location and exceeds 15 NTUs, work will be suspended until it can be determined what is causing the increased turbidity and the situation is rectified.

Landfill Gas Monitoring

As part of the RA, landfill gas probes will be installed and monitored on the southern side of the property, along the MDNR's property, and along the asphalt plant property. Landfill gas vents will also be installed and monitored in the landfill cover. The general scope of the landfill gas monitoring includes the following activities:

- Install six gas probes at locations spaced approximately 250 feet apart.
- Monitor the gas in the probes for combustible gas, carbon dioxide and oxygen concentrations (as a percent by volume), using a portable combustible gas meter. Pressure will also be measured at the gas probes. The samples will be collected and analyzed in accordance with SOP F-7 (see Attachment A). The results of the gas monitoring will be evaluated in accordance with Section 3.4 of the PSVP (RMT, 2008d).

- Assess nuisance odors at the property line concurrent with the monitoring of the gas probes, If nuisance odors are detected, then contingency actions will be taken as described in Section 3.4.2 of the PSVP (RMT, 2008d).

Groundwater Monitoring

As part of the RA activities, groundwater monitoring wells will be installed and monitored on the upgradient and downgradient edges of the landfill. The general scope of the groundwater monitoring activities includes the following:

- Install a total of nine shallow groundwater monitoring wells, including two shallow monitoring wells along the upgradient edge of the landfill and seven shallow monitoring wells along the downgradient edges of the landfill. In addition, install a total of three deep groundwater monitoring wells, including one deep monitoring well on the upgradient edge of the landfill and two deep monitoring wells on the downgradient edges of the landfill. The wells will be constructed and developed in accordance with the procedures described in the groundwater monitoring plan (Section 4.4 of the PSVP [RMT, 2008]).
- For at least the first 2 years of monitoring, collect groundwater samples on a quarterly basis from the seven shallow monitoring wells along the downgradient edges of the landfill. During each round of monitoring, the groundwater samples will be analyzed for PCBs, VOCs on the Target Compound List (TCL) for organics, mercury, cyanide, magnesium, and sodium. The samples will be analyzed for additional parameters on a semiannual basis, including semivolatile organic compounds (SVOCs) on the TCL for organics, the remaining metals on the Target Analyte List (TAL) for inorganics, and dioxins. Field parameters will be measured in the groundwater monitoring wells, including groundwater levels, turbidity, temperature, pH, and conductivity. The groundwater samples will be collected in accordance with SOP F-11 (see Attachment A).
- Measure water levels in the two shallow monitoring wells along the upgradient edge of the landfill and in the three deep monitoring wells.
- Measure surface water levels at a staff gauge in the Kalamazoo River.
- Perform decontamination, and manage investigation-derived waste in accordance with Sections 6.1.3 and 6.2.3.
- After the first 2 years of groundwater monitoring, Weyerhaeuser may petition the U.S. EPA to reduce the monitoring frequency, as described in Section 4.8 of the PSVP (RMT, 2008).

2.7.2 Sample Locations

Specific sample locations depend on the types of samples being collected and on the field conditions. Many sample locations will be established in the field (*i.e.,* soil samples, ambient air samples, and surface water samples), based on site-specific conditions that impact the ability to collect representative samples and the guidelines in the Design Report, QAPP, and this FSP. The locations of the groundwater monitoring wells and the landfill gas probes and vents are shown on Figure 2-1. Available information by sample type is summarized in Table 2-6.

Section 3
Sample Designation, Control, and Field Records

3.1 Sample Designation

Samples will be assigned a unique alpha-numeric sample descriptor identifying the media types, the sample location, and in certain instances, the sample depth (or sample number). Each sample will be labeled as follows:

[sample location] - [sample matrix] - [sample number] - [sample date] (YYMMDD)

The following sections discuss the sample numbering system in greater detail.

3.1.1 Sample Location

The first entry for each alpha-numeric sample descriptor will be a sample location designator, which will be assigned as described below.

- PDC: Former Powerhouse Discharge Channel
- LF: 12th Street Landfill
- PM: Plainwell Mill
- WTS: Water Treatment System

3.1.2 Sample Matrix

The second portion of each alpha-numeric sample descriptor will be a two-letter alphabetical code that describes the sample matrix. Matrix codes for the investigation are as follows:

- “SD” for sediment
- “SW” for surface water
- “SL” for soil
- “EW” for effluent water from treatment system
- “FB” for field blanks
- “TB” for trip blanks
- “FD” for blind field duplicate samples

3.1.3 Sample Number

For environmental samples, a unique sample number will be designated for each new physical sample collected. For example soil boring number one at the Plainwell Mill will be named WYPMSL01. For soil or sediment borings where more than one subsurface sample is obtained at a given location, each sample name will include a "D" followed by the sample depth range in feet (*e.g.,* 0 to 0.5 feet; WYPMSL01D0.0.0.5ft). Water samples taken at a specific depth will only include the specific depth (not a range). In addition, the sample name will also include an identifier for the specific monitoring location upstream or downstream of the work activities and its relative monitoring position moving from upstream to downstream (*e.g.,* first upstream location, U1; downstream of activities and downstream of two other sampling stations, D3). The position of each surface water station will be recorded with a GPS and written into the appropriate field log book. The specific depth interval at which each sample is collected will be recorded to the nearest tenth of a foot in the comments section of the Chain-of-Custody Record and in the appropriate field notebooks.

For QA/QC samples such as field blanks, trip blanks, and blind duplicates, samples will be numbered sequentially beginning with "001" and will be recorded in the appropriate field notebook. A sample for which additional volume is collected for matrix spike/matrix spike duplicate analyses will have the suffix of "-MS/MSD" added to the sample identification number.

3.1.4 Sample Date

For each sample the date and time that the sample was collected using 2-digit numeric codes for the year, month, and date of the sample (*e.g.,* 070501 would be the sample date for a sample collected on May 1, 2007) and military time (24:00). The sample time will be noted in the appropriate field log books and on the COC.

Example Sample Description	Associated Sample Naming Convention
The first sediment boring collected in the former powerhouse discharge channel. Depth collected was 1 to 2 feet. Sample date and time was July 1, 2007, at 1:00 p.m.	WYPDCSD01D1.0.2.0ft
Fifth water surface sample collected at the second downstream monitoring location at the powerhouse discharge channel. Surface water sample collected at a mid-depth of 3 feet on July 2, 2007, at 7:00 a.m.	WYPDCSW05D3.0ftD3

3.2 Sample Containers and Preservation

The sample containers, preservation and handling procedures will follow the standard analytical requirements as described in the QAPP and collection procedures described in the SOPs. The analytical laboratory will supply the appropriate containers for sample collection and preservation. The field personnel is responsible for proper collection, labeling, recording and preservation (*i.e.,* on ice) of samples. Sample containers will be labeled in accordance will the sample designation described in Section 3.1.

3.3 Chain-of-Custody Procedures

The sampler is responsible for sample custody from the time of sample collection to receipt at the laboratory or until samples are shipped by commercial carrier. A sample is considered under custody if one of the following conditions apply:

- The sample is in a person's possession.
- The sample is in that person's view after being in his or her possession.
- The sample was in that person's possession and then placed in a secured location.
- The sample is in a designated secure area.

Sets of sample containers that are shipped together will be assigned a Chain-of-Custody Record, which will travel with the sample containers. A copy of the Chain-of-Custody Record with its assigned sample numbers will be kept in the laboratory to help identify samples that might become separated from the discrete sample delivery group. When shipped by a commercial carrier, custody seals will be attached to each cooler to ensure that tampering with the samples does not occur in transit, and the shipment airbill will be kept as Chain-of-Custody documentation.

3.4 Field Records

This section of the FSP describes requirements and procedures for documentation of field activities. It is essential that all field documentation provide a clear, unbiased description of field activities. Examples of all of the forms mentioned in this FSP are included in Attachment B.

3.4.1 Daily Log

Serially numbered, bound field notebooks will be used on work assignments requiring field activities. Daily field activities will be recorded in the bound field notebooks. In addition, several sample collection notebooks will contain bound sample collection forms, including soil boring logs, monitoring well construction diagrams, monitoring well development forms, groundwater sampling summary forms, and groundwater and surface water level measurement forms. Representative forms are provided in Attachment B. The on-site coordinator (OSC) will be responsible for issuing field notebooks. A record will be maintained by the OSC documenting the assignment of field notebooks. The OSC will distribute and track bound and numbered field notebooks. Transfers of field notebooks to other individuals (including subcontractors) who have been designated to document specific tasks on the project will be recorded. No field notes may be destroyed or discarded, even if they are illegible, or known to contain inaccuracies.

Entries into field notebooks will be legibly written and will provide a clear record of field activities. Entries will be made in waterproof ink and in language that is objective, factual, and free of personal opinions or terminology that might later prove unclear or ambiguous. Errors in the field notes will be indicated by drawing a single line through the text, such that the text in error remains legible. Errors addressed in this manner will be initialed and dated by the person making the correction. The person taking notes in the field notebook will sign, number, and date each page and will document the date, time, location on site, name of field personnel present, and weather conditions observed. Specific sample collection methods will be included in the field notes.

Field personnel responsible for taking notes will log photographs in the field notebook. Locations of the photographs will be referenced to a site sketch or map. Use of measurements and readings from on-site health and safety equipment will be recorded. Observed potential hazards to health and safety will be described. The level of protection and the decontamination procedure used will be documented.

3.4.2 Soil Boring Logs

Soil borings completed by the field team will be documented in a Soil Boring Log. The log will document the drilling locations, drilling dates and times, names of drilling personnel and logging personnel, soil descriptions, sample depths, and recovery.

3.4.3 Soil Sample Logs

Soil samples collected by the field team will be documented in a Soil Sample Log. The log documents the sample identifiers; soil types; sampling times, depth and location of each sample; sampling equipment used; color, odor, and appearance of the samples; sample parameters; container descriptions; sample preservatives; and names of sampling personnel.

3.4.4 Water Sample Log

All surface water and/or groundwater samples collected by the field team will be documented in a Water Sample Log. The log will document the sample identifiers, replicate identifiers, if any; purging (groundwater) and sampling times and locations; sampling equipment; color, odor, and appearance; sample container descriptions; sample preservatives; and sampling personnel.

3.4.5 Sediment Sample Log

All sediment samples collected by the field team will be documented in the Sediment Sample Log. The log will document the sample identifiers, replicates, sample times, date and location. In addition, sediment appearance, type color, odor etc, will be described. Sample containers, preservatives and sampling personnel will be recorded in the Sediment Sample Log.

3.4.6 Chain-of-Custody Record

The Chain-of-Custody (COC) Record is a multi-copy record, which documents the custody of the samples from sample collection through laboratory analysis. The record includes spaces for signatures of those receiving and relinquishing the samples. The sampler, the individual preparing the samples for shipment, and the individual receiving the samples at the laboratory normally sign the record.

The field personnel collecting the sample will fill out the COC Records. The COC process will be initiated upon sample collection. The field person who signs the record will be responsible for the samples until they are transferred to the custody of the laboratory or another custodian. Once the record has been completed, all remaining field sample identification spaces will be crossed through to prevent unauthorized addition of sample information.

The information required on the COC Record includes the complete sample identifier, date and time of sample collection; number of sample containers; analyses and methods required; container type; project number; name of sample collection personnel; complete name, address, and telephone number of the person who will receive analytical reports; turnaround time; and signatures of all sample custodians, excluding shippers. In addition, the method of shipment, and the courier’s name and air bill number must be included. The back copy of the record will be retained. The original record will accompany the sample shipment to the laboratory.

3.5 Photographs

As discussed in Subsection 3.4.1, photographs taken in the field will be documented in the field notebook at the time the photograph is taken. Locations of photographs will be referenced to a site sketch or map. After the film is developed or the images are uploaded onto a computer, the photographs will be labeled with the following information:

- Project identification number
- Date
- Location
- Direction viewed in photograph

- Roll number (if applicable)
- Frame number
- Sample number (if appropriate)
- Initials of the photographer

Section 4
Sample Handling and Analysis

This section presents general sample handling and analysis protocols. Additional detailed information is contained in the QAPP.

4.1 Sample Containers and Shipping

A table summarizing the sample containers, preservation methods, and holding times for solid and liquid samples, which are collected under this Multi-Area FSP and intended for chemical analyses, is provided in Worksheet #19 in the Multi-Area QAPP. These sample containers, preservation methods, and holding times meet U.S. EPA and Michigan Department of Environmental Quality (MDEQ) standards. For samples intended for VOC analysis, the sample containers will be filled completely to minimize airspace. Sample containers for other analytical group analyses will be filled to nearly full to avoid overtopping and loss of preservative (if applicable), and to meet the minimum sample volume/mass required by the laboratory (see Worksheet #19 in the Multi-Area QAPP). Soil samples intended only for physical testing (*e.g.,* grain size) will be placed in clean glass jars (minimum 8-oz. volume).

From the time the samples are collected and labeled until delivery to the laboratory, samples will be kept in a dark or otherwise lower temperature location, on ice and within a hard plastic ice chest or cooler that has a white interior. For delivery of samples to the laboratory, the following procedure will be implemented:

1. Collect and preserve the samples as outlined in the FSP and QAPP.
2. Place sample containers in a laboratory shipping container(s). Samples will be packed securely with packing material to protect sample containers from accidental breakage during shipment and to prevent leaks or spills.
3. Fill shipping container with enough ice to last the trip. Double-bag the ice to ensure sample integrity. Dry ice and/or blue ice (ice packs) will not be used.
4. Complete the Chain-of-Custody Record as described in Subsections 3.3 and 3.4.6 and in the QAPP.
5. Tape the Chain-of-Custody Record to the inside of the shipping container lid.
6. Seal shipping container with strapping tape, and place a custody seal (provided by the laboratory) on the shipping container prior to shipping.
7. Deliver or ship the container to the laboratory using an overnight shipping service.

Responsibility for proper use of containers and preservatives will be under the oversight of the OSC.

4.2 Selection of Parameters

The number and location of the samples to be collected and the selection of parameters to be analyzed are summarized in Tables 2-1 through 2-4 and in Worksheets #17-1, #17-2, #17-3, #17-4, #18-1, #18-2, and #18-3 in the Multi-Area QAPP.

4.3 Analytical Procedures

The selection of analytical procedures reflect U.S. EPA-approved methodology from the SW-846 Methods and MDEQ-approved methodology under the Michigan Part 201 Program, where applicable, as stated in the QAPP. Other methods designed to meet project-specific objectives are also defined in the QAPP. A list of the analytical procedures is provided in Worksheet #23 in the Multi-Area QAPP.

4.4 Sampling Quality Assurance Procedures

The sample collection procedures presented in this FSP are designed to provide samples of the required quality to meet site investigation objectives. All field personnel will be required to understand the requirements of this FSP and will be trained in the use of the specified equipment and techniques.

The RMT OSC is responsible for reviewing the day-to-day activities to ensure that the procedures in the FSP are followed. Specific activities that will be implemented by the OSC include the following:

- Convene a meeting of field personnel at the start of a specific sampling event to review the sampling requirements of the FSP, the necessary equipment and decontamination requirements and use, and the required documentation.
- Review all documentation on a daily basis for completeness, errors, problems, and corrective actions taken.
- Convene daily project team meetings at the start of the day to discuss health and safety, to address any problems developed during the previous day’s work, and to review the work to be completed that day.
- Manage the implementation of in-field corrective actions. The RMT project manager will be notified of significant problems and, if necessary, will work with the OSC to develop corrective actions. The project manager will be responsible for implementing corrective actions that need to be applied to areas other than field activities.

4.4.1 Field Measurements

The equipment used for in-field measurement will be maintained, calibrated, and operated in the field according to the procedures described in the select SOPs in Attachment A. Field calibration of equipment is described within the QAPP Worksheet #22. The process will be documented, and the OSC will periodically review the documentation and inspect the equipment to ensure that the procedures are followed by the personnel collecting the samples. Significant deviations from the FSP, errors, equipment failures, or other problems will be documented in a bound notebook by the OSC and reported to the RMT project manager. Corrective actions and additional notifications will be coordinated by the project manager.

4.4.2 Sample Collection

Personnel involved in the collection of samples are required to read, understand, and follow the procedures specified in this FSP. Problems that may affect the quality of the sampling effort will be documented by the field personnel most directly involved with the problem, and the OSC will be notified. The OSC is responsible for coordinating the development and implementation of corrective actions with the RMT Project Manager.

4.4.3 Field Data Reduction

Raw data from field measurements and sample collection activities will be recorded in the field logs as specified in Section 3.4. With the exception of the temperature correction for specific conductance, no calculation will be required in field data reduction. Only direct-reading instrumentation will be employed in the field. The OSC will proofread all forms and notebooks to for consistency with the planned activities and to also determine if transcription errors have been made by the field crew.

4.4.4 Analytical Quality Assurance Considerations

Field Duplicates

Blind field duplicate samples, prepared by splitting a single sample into two separate containers, will be used to evaluate sampling precision. Points at which duplicate samples are to be collected will be selected by field personnel and will be submitted as blind duplicates to the laboratory. Field personnel are expected to provide a general range of expected concentrations to the laboratory for these samples to minimize impacts on laboratory equipment.

Blind field duplicates will be collected at a frequency of one sample per 10 primary samples for soil and groundwater matrices, as summarized in Worksheet #20 in the Multi-Area QAPP. Sample identification protocols are provided in Subsection 3.1 of this FSP.

Field Equipment Blanks

Field equipment blanks consisting of analyte-free water will be collected and submitted to the analytical laboratory to assess the quality of the data resulting from the field sampling program. Field equipment blanks are analyzed to check for procedural contamination at the site that may cause sample contamination. Field blanks will be collected following decontamination of the nondedicated sampling equipment, including pumps and soil samplers. Field blanks will not be collected for disposable or dedicated sampling equipment, such as tubing dedicated to a specific well.

Field equipment blank frequencies are also provided in Worksheet #20 in the Multi-Area QAPP. In general, field equipment duplicates will be collected at the rate of one duplicate per ten primary samples for groundwater and soil matrices. The exception is the low-level mercury sampling locations, at which one equipment blank will be generated for each location sampled. Identification protocols are provided in Subsection 3.1 of this FSP.

Trip Blanks

Trip blanks will be analyzed to assess the possible cross-contamination of VOCs resulting from diffusion through septa during sample shipment. Trip blanks, consisting of 40-mL VOA vials with deionized ASTM Type 2 organic-free water, are generated in the laboratory and accompany VOC sample coolers from the laboratory to the field and back to the laboratory. Trip blank containers are not opened in the field. Trip blanks prepared by the laboratory will meet holding time requirements. One trip blank, consisting of two VOA vials, will be shipped with each cooler containing VOC sample containers. Trip blank identification protocols are provided in Subsection 3.1.

Field Blanks

Field blanks will be analyzed to assess the suitability of the container, preservative, and sample handling. The field blank is generated by pouring the solution provided in one of the sample containers into another sample container the contents of which had been emptied at the facility. One field blank will be collected per every 10 primary samples, as described in Worksheet #20 in the Multi-Area QAPP.

Field blanks will be denoted by "F" followed by a 3-digit number, similar to the system used for duplicate samples (F-001-[Date], F-002-[Date]).

Matrix Spikes/Matrix Spike Duplicates (MSs/MSDs)

MS/MSD samples provide information about the effect of the sample matrix on the sample preparation and measurement methodology. MS/MSD samples will be analyzed in accordance with the laboratory operating procedures provided in the QAPP. In conjunction with other QC data, the spikes and duplicates give information on the precision and accuracy of the analytical method on the various sample matrices. One

MS/MSD sample will be collected and prepared for every 20 or fewer primary samples collected during a sampling round, as described in Worksheet #20 of the Multi-Area QAPP. The MS/MSD samples will consist of triple the normal sample volume for each analytical group, provided adequate sample volume is available. Field personnel will select the sampling locations at which MS/MSD samples are collected. MS/MSD identification protocols are provided in Subsection 3.1.

4.5 Field Audits

The Project Manager/Coordinator will monitor daily field performances through daily communications with the OSC and Construction Manager. Field performance audits and field system audits will be performed as follows:

- Field performance audits will be conducted in order to confirm that the activities are being performed according to the established plans. The field performance audits will be performed by the Senior Consultant QA Manager (or designee) at an appropriate frequency for the field activities. The audits will include a discussion of the project progress with the Project Coordinator and /or the review of field reports, as appropriate. The Senior Consultant QA Manager will record and document any observations made during field system audits, and will discuss the audit and any recommended changes/deviations to the field procedures with the project coordinator.
- Field system audits will be performed by the data QA manager including a review of rinse and trip blank data to identify potential deficiencies in field sampling and decontamination procedures, and a comparison of the scheduled QA/QC activities described in the QAPP with the QA/QC procedures being performed on the project. Field system audits will be performed at a frequency appropriate for field activities. The Data QA Manager will record and document any observations made during field system audits, and will discuss the audit and any recommended changes/deviations to the field procedures with the Project Coordinator.

4.6 Corrective Action

Field measurement corrective action may be necessary when the sample network is modified or when sampling procedures and/or field analytical procedures require modification in response to unexpected conditions. Technical staff and project personnel will be responsible for reporting all suspected technical or QA nonconformances or deficiencies of any activity or issued document by reporting the situation to the RMT on-site Field Sampling Coordinator or designee. The Field Sampling Coordinator will assess the suspected problems in consultation with the Project Coordinator or Data QA manager or designee, and will assist in making a decision based on the potential for the situation to impact the data quality. If it is determined that the situation warrants a reportable nonconformance requiring corrective action, the OSC will issue the nonconformance report. If appropriate, the RMT Field Sampling Coordinator will ensure that no additional work is dependent on the nonconforming activity is performed until the corrective actions are completed.

Details regarding laboratory data reduction, validation and reporting requirements are provided in Worksheet #14 and Worksheets #34 through #36 of the QAPP. In addition details on field and laboratory audits and corrective actions are included in Worksheets #6-1, #6-2, #6-3, #14, and #31-1, #31-2, #32-1, #32-2, and #33 in the Multi-Area QAPP.

Section 5
Field Physical Measurements

Field measurements of topographic features, water levels, reference points, and other physical features will be required during the field investigations. The scope of such measurements depends upon the purpose for the particular measurement data.

Physical measurements will be traceable to the person making the measurement and to the specific piece of field equipment used to make that measurement. Equipment maintenance and calibration records will be kept in a bound field notebook, making all such procedures traceable. Time records will be kept using local time in the 24:00-hour military format, recorded to the nearest 5 minutes.

Sampling locations will be surveyed and depicted on existing topographic maps. Surveying will be conducted according to the standard procedures described below. Control points used during the survey will be marked in the field and noted on the topographic maps.

5.1 Surveying of Sampling Locations

Accurate, complete, and informative surveying field notes are a primary objective in site mapping. The field notes are the most reliable record of measurements made and information gathered in the field. As stated in Subsection 3.4, information gathered will be recorded in bound notebooks. Notes will be permanent, legible, and complete.

The field notes will accomplish the following:

- Provide adequate and complete information that can be understood by someone other than the notetaker.
- Provide documentation of work completed or data gathered.

Two important aspects of each survey to be addressed in the field notes are as follows:

- ***Starting and ending points of the survey*** - The surveyor will explain and document the starting and ending points of the survey. This applies to both horizontal and vertical control. This will require a paragraph of explanation and sketches and/or cross-references to data in notes of previous surveys.
- ***Clear indication of final results and checking procedures*** - The final results and checks will be plainly indicated. Erasures will not be used, as they raise uncertainties about the reliability of the data. Alterations, additions, revisions, reductions, or comments added to field notes will be written in colored ink to indicate that such information is not part of the original field record. The person making such notations will initial and date each page so affected.

The following is a checklist of information to be included in the notebook:

- Date
- Names of survey crew members
- Weather conditions: observed temperatures, relative wind speed, and barometric pressure if an electronic distance meter (*e.g.,* a total station) is to be used
- Equipment used, listing the serial number or other identification
- Location of survey by section description or other legal parcel identification
- Project number
- North arrow
- Description of all monuments found
- Measurements (slope distance and vertical angles, temperature, taping, horizontal angles, etc.)
- Corrected distances and angles
- Description of monuments set
- Outline or sketch of major traverse or property boundary

The elevation of the measuring point of monitoring wells and a reference point on staff gauges will be surveyed to allow correlation of water levels. Additionally, ground elevations may be required for topographic purposes. Standard engineering leveling techniques, as described in basic surveying textbooks, establish the methodology for providing vertical control. The datum referenced for elevation control is the National Geodetic Vertical Datum (NGVD) of 1929, informally known as sea level datum, established by the U.S. Coast and Geodetic Survey. Benchmarks of known elevation will be used. If no benchmark is located in the vicinity of a site investigation, an arbitrary temporary benchmark will be established on a permanent location (*i.e.,* foundation or corner post). The locations of benchmarks utilized will be shown on a site sketch map. Elevation surveys will be conducted to form a circuit (*i.e.,* the survey line will be closed back to a benchmark). Third-order accuracy will be obtained on level circuits; for example, on a 1-mile circuit, the closure will be within 0.05 foot. Length of sight will not ordinarily exceed 250 feet, with turning point back-shots and fore-shots deviating no more than 50 feet from one another.

5.2 Surface Water Stage

Surface water stage will be measured on staff gauges graduated to 0.01 foot. Staff gauges will be surveyed at the same time that monitoring wells are surveyed, and will be referenced to NGVD. Measurements of water stage will be noted in field logs with date, time, and site location. Water stage will be recorded to the nearest 0.01 foot.

Section 6 Management of Investigation-derived Waste

6.1 Purge Water and Decontamination Water

6.1.1 OU-4 and OU-5 Emergency Actions

Wastewater produced from well development and well purging and decontamination water will be temporarily stored in appropriately sized container. This water will be appropriately managed, as follows.

- All decontamination water generated during cleaning of equipment will be stored in a temporary storage tank(s) at the site.
- During operations, the water will be treated in the on-site treatment system.
- Decontamination water that is generated after the treatment system is unavailable will be characterized to identify appropriate methods of off-site treatment and/or disposal. The water samples will be analyzed for the analytes required by the treatment and/or disposal facility.

6.1.2 OU-4 Predesign Investigation

Decontamination activities performed during the predesign investigation at OU-4 will be performed at a decontamination pad constructed on top of the landfill. The decontamination pad will be roughly 15 feet wide and 25 feet long and will generally consist of a flexible membrane liner (FML) placed over an area on top of the landfill that is gently sloped and bermed so that the decontamination water will flow to one location to be collected. Wood or a thin layer of soil may be placed on top of the FML so that equipment can be driven on the pad without potentially puncturing the FML. The actual construction of the decontamination pad may be modified based on the selected contractor's means and methods.

Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Predesign Studies (to be submitted as part of the Design Report).

Following completion of the predesign field activities, the decontamination pad will be dismantled and the bermed soil will be regraded to match the existing cover slope. The decontamination pad materials will be stockpiled and covered with the existing cover soil in a designated area that will not erode before the final cover is installed. These materials will be incorporated under the final landfill cover as part of the RA.

6.1.3 OU-7 – Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment

Decontamination water will be collected and containerized in 55-gallon barrels that will be property labeled and temporarily stored on-site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the technical memorandum documenting the findings and conclusions of the Plainwell Mill RI/FS – Phase I Groundwater Assessment activities.

6.1.4 OU-4 Remedial Action

Decontamination activities performed during the predesign investigation at OU-4 will be performed at a decontamination pad constructed near the site entrance of the landfill. The construction of the decontamination pad will be based on the selected contractor's means and methods, but may consist of an approximate 8-foot by 8-foot piece of HDPE flatstock with 6-inch–high sides or a roughly 15-foot–wide and 25-foot–long FML placed over an area near the site entrance that is gently sloped and bermed so that the decontamination water will flow to one location to be collected. Wood or a thin layer of soil may be placed on top of the FML so that equipment can be driven on the pad without potentially puncturing the FML.

Decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on site. A sample of the decontamination water will be collected and tested for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the report documenting the remedial action construction.

6.2 Soil

6.2.1 OU-4 and OU-5 Emergency Actions

Excess soil and samples that are produced during the drilling operations will be temporarily stockpiled at each drilling site and placed on a plastic liner. In the event of rain, and at the end of each work day, the pile will be covered with a plastic sheet. As drilling is completed at each work area, the temporary stockpile will be collected and placed into the sediment management areas at the top of the 12th Street Landfill, or into roll-off bins, barrels, 5-gallon buckets, or equivalent located in the primary staging area. After all drilling operations are completed, samples of the accumulated soil will be collected and characterized in accordance with landfill profile requirements. After determining the proper regulatory classification, the soil will be transported for off-site disposal at the 12th Street Landfill site or another permitted disposal facility (if necessary).

6.2.2 OU-4 Predesign Investigation

After the test pits are logged, the excavated material will be placed back into the excavation and compacted sufficiently to prevent erosion from surface water runoff. Vegetation will be reestablished through natural propagation of native species.

Soil cuttings generated during the drilling of Geoprobe® borings will either be placed in appropriately labeled containers (*e.g.,* 55-gallon barrels) or stockpiled and covered with a low-permeability material in a designated area that will not erode before the final cover is installed. These materials will be incorporated under the final landfill cover as part of the RA.

6.2.3 OU-7 – Phase 2 of Addendum No. 1 (Test Pits)

The soil excavated while performing test pits will initially be placed on a tarp to minimize contact with surface soils. If test pit soils are visually stained, have a strong petroleum odor, or as measured with a PID indicate volatiles greater than 10 (PID units), excavated soils will be containerized in a small lined 5 cubic yard dumpster for landfill characterization and disposal. Three small dumpsters will be on site during the investigative activities to manage contaminated soil encountered from the area of oil impacted soil and elevated PCB area separately and one extra, for use as needed. If soils appear to be native or other non-contaminated fill materials, the soil will be placed back into the original excavation area.

6.2.4 OU-7 – Plainwell Mill RI/FS – Phase I Initial Groundwater Assessment

Excess soil and samples that are produced during the drilling operations will be temporarily stockpiled at each drilling site and placed on a plastic liner. As the drilling activities are completed in each area the temporary stockpile will be collected and placed into 55-gallon drums. After all drilling activities are complete samples of the accumulated soil will be collected and characterized in accordance with landfill profile requirements. After determining the proper regulatory classification, the soil will be transported for off-site disposal.

6.2.5 OU-4 Remedial Action

Excess soil and samples that are produced during the drilling operations will be temporarily stockpiled at each drilling site. As drilling is completed at each work area, the temporary stockpile will be collected and the soil may be thinly spread over areas on the landfill final cover or site access roads. The soil may also be used to backfill erosional channels on the landfill final cover or site access roads.

6.3 Used Personal Protective Equipment and Noncontaminated Refuse

Used personal protective equipment and other types of general noncontaminated debris or waste materials produced during the fieldwork will be collected daily in sealed plastic bags, and placed in a waste dumpster that will be brought to the site for the project. The wastes will be disposed by a local commercial waste disposal contractor at the end of the fieldwork.

Section 7 References

RMT, Inc. 2008a. Multi-Area quality assurance project plan, Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Revision 02, Addendum 03. September 2008.

RMT, Inc. 2008b. Remedial design workplan, 12th Street Landfill, Otsego Township, Michigan. Operable Unit No. 4 of the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund site. Revision 0. April 2008.

RMT, Inc. 2008c. Remedial design report.

RMT, Inc. 2008d. Performance standards verification plan.

USDA. 2004. Wells, R., E.J. Langendoen, and A. Simon. Numerical simulation of sediment loads and channel changes along the Kalamazoo River between Plainwell and Otsego City, Michigan. USDA-ARS National Sedimentation Laboratory Research Report. No. 44. 46 pp.

USGS. 2004. Syed, A.U., J. P. Bennett, and C.M. Rachol. A pre-dam-removal assessment of sediment transport for four dams on the Kalamazoo River between Plainwell and Allegan, Michigan. U.S. Geological Survey Scientific Investigations Report 2004-5178. 41 pp.

Table 2-1
Summary of Sample Types and Locations (Former Powerhouse Discharge Channel)

Type of Sample	Assumed Location	Purpose
Surface Water Quality	Immediately upstream or near the Plainwell Spillway. Mid depth in the water column.	Establish background conditions for turbidity comparisons.
	Approximately 200 and 300 feet downstream of the former powerhouse discharge channel. Sample within the channel may be collected from pier or boat depending upon flow conditions. Mid-depth in the water column.	Establish water quality during removal activities.
	Groundwater collection sump (or equivalent) within isolated removal area (discharge water).	Measure turbidity for comparison to background conditions and determination of discharge location.
Surface Water Flow Measurements	To be determined if needed.	To be determined if needed.
Water Treatment System Monitoring	Effluent sampling from Portable Treatment unit.	To confirm treatment system effectiveness.
Sediment Sampling	At selected nodes within a final sampling grid. Grid size depends upon the final size of the removal area. Node selections will consider random and spatially distributed locations. Samples will be collected within the top 6 inches of sediment.	Document PCB sediment concentrations after removal is complete.
Geoprobe Soil Sampling	Predesign sample collection at transects along the edge of the landfill closest to the former powerhouse discharge channel.	Determine possible existence of former berm at edge of landfill and assess collected soil samples for implications on slope stability.

Table 2-2
Summary of Sample Types and Locations
(Plainwell Mill Banks)

Type of Sample	Assumed Location	Purpose
Surface Water Quality	Immediately upstream or near the Plainwell Mill banks. Mid depth in the water column.	Establish background conditions for turbidity comparisons. Turbidity will be measured hourly.
	Approximately 200 and 300 feet downstream of the Plainwell Mill banks. Sample within the channel may be collected from pier or boat depending upon flow conditions. Mid-depth in the water column.	Establish water quality during removal activities. Turbidity will be measured hourly
Surface Water Flow Measurements	To be determined if needed.	To be determined if needed.
Water Treatment System Monitoring	Effluent sampling from Portable Treatment unit.	To confirm treatment system effectiveness.
Sediment Sampling	At selected nodes within a final sampling grid. Grid size depends upon the final size of the removal area. Node selections will consider random and spatially distributed locations. Samples will be collected within the top 6 inches of sediment.	Document PCB sediment concentrations after removal is complete.
Soil Sampling	At selected nodes within a final sampling grid. Grid size depends upon the final size of the removal area. Node selections will consider random and spatially distributed locations. Samples will be collected within the top 6 inches of soil.	Document PCB soil concentrations after removal is complete.

Table 2-3
Summary of Sample Types and Locations
(Predesign Investigations for the Remedial Design for the 12th Street Landfill)

Type of Sample	Assumed Location	Purpose
Test Pits (visual)[1]	***Wetland Area to the North of the Landfill*** - Advance approximately 3 test pits to confirm the approximate areal extent of visible paper residuals beyond the toe of the landfill. ***Asphalt plant/State Properties -*** Advance approximately 3 test pits within the asphalt plant property and approximately 4 test pits within the State property to delineate the areal extent and the depth of visible paper residuals.	***Wetland Area to the North of the Landfill*** - Evaluate potential constructibility issues in the wetland, and to assess the degree of difficulty in distinguishing the visible paper residuals from the native soil. ***Asphalt plant/State Properties*** - Support discussions with the owners of these adjacent properties concerning access for implementation of the Remedial Action.
Geoprobe® Borings (visual)	Advance approximately 9 Geoprobe® borings into the 12th Street Landfill at select locations where fill material is believed to extend beyond the property boundary to the southwest and to the southeast and a minimum of 2 Geoprobe® borings near the southern end of the landfill. The borings will be advanced to approximately 5 feet into the native soil underlying the fill, or to refusal.	Better estimate the depth of the paper residuals along the property boundaries with 12th Street, the asphalt plant to the southwest, and with the State property to the southeast, in order to reduce uncertainties in designing the final landfill grades.
Gas Monitoring	Measure gas concentrations (methane, oxygen, and carbon dioxide) and pressures at the existing groundwater monitoring wells screened in the vadose zone (MW-6A, MW-7A, and MW-8A). In addition, measure gas concentrations at each Geoprobe® boring used to better estimate the depth of the paper residuals along the property boundaries to the southwest and to the southeast.	To collect readily accessible information about the subsurface landfill gas conditions at the 12th Street Landfill that may be useful in designing a passive gas venting system.

Note:
(1) In the event that in-field conditions limit the use of test pit excavating equipment (*e.g.,* a backhoe), other tools, such as hand augers or shovels, may be used instead.

Table 2-4
Summary of Test Pit Sample Types and Locations

Type of Sample	Assumed Location/ Estimated Sample Number	Purpose
Test Pit Samples	Oil Impacted Soil Area – Estimated 10 test pits	Test pits will be used to identify the source of the oil impacted soil as well as the extent of area impacted. Test Pits will also be used to inspect the area in the vicinity of the oil impacted soil. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons.
	Elevated PCB Area – Estimated 5 test pits along the bank of the Kalamazoo River	Test pits will be used to evaluate whether the two areas of concern are related and whether NAPL, if present is the cause of the high PCB concentrations observed and if there is potential for NAPL to enter the river. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons.

Table 2-5
Summary of Groundwater Sample Types and Locations

Type of Sample	Assumed Location/ Estimated Sample Number	Purpose
Groundwater Samples	Mill Buildings Area – Install five groundwater wells and two staff gages. Northcentral Portion of the Site – Install three groundwater wells. Former Wastewater Sludge Dewatering Lagoons – Install four groundwater wells and one staff gage.	Groundwater well samples will provide additional information on groundwater quality for comparison to applicable ARARs and completion of the risk assessment. In addition, groundwater wells will provide key information regarding the interface between the groundwater system and the river system and the direction of the groundwater gradient at the site.
Staff Gage	Three staff gages will be placed along the bank of the Plainwell Mill. The first will be placed at the upstream end of the Mill Race. The second gage will located near the mill buildings in the Kalamazoo River and the third downstream near the wastewater sludge dewatering lagoons.	Staff gages will be used in conjunction with the groundwater wells to determine the groundwater flow direction onsite. In addition, the slope of the river along the bank of the Plainwell Mill.

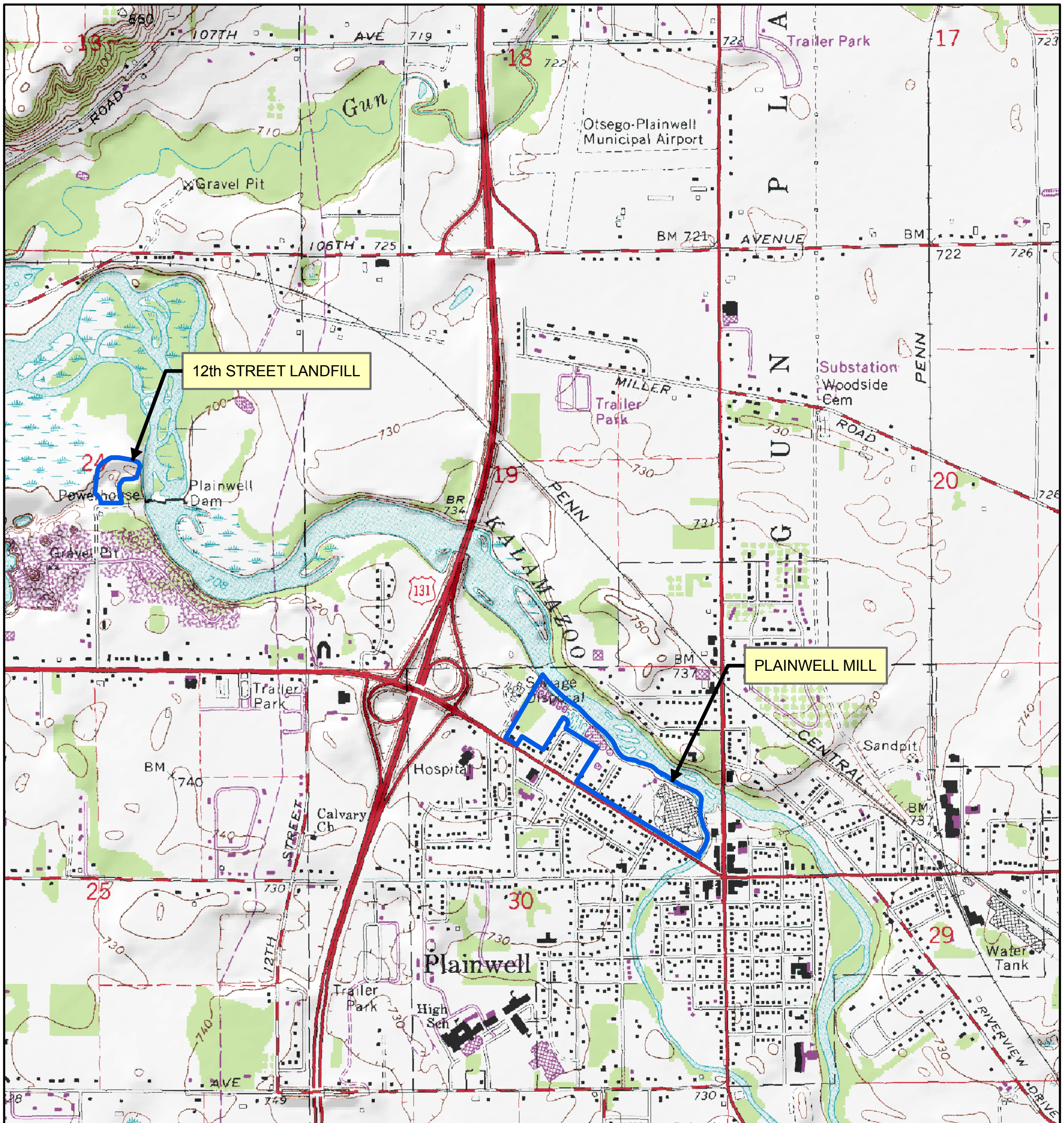
Table 2-6
Summary of Sample Types and Locations
(Remedial Action for the 12th Street Landfill)

Type of Sample	Assumed Location	Purpose
Verification Soil Sampling(1)	***MDNR's Property*** – Collect approximately nine soil samples at the base and sidewalls of the excavation, and analyze the samples for PCBs. ***Asphalt Plant Property*** – Collect approximately 13 soil samples at the base and sidewalls of the excavation, and analyze the samples for PCBs and VOCs.	To demonstrate compliance with the lowest of the Part 201 GRCC in *Table 2. Soil: Residential and Commercial I*, of the MDEQ's Remediation and Redevelopment Division's Operational Memorandum No. 1 (January 23, 2006). For PCBs, the applicable criterion is 4 mg/kg, which is the criterion for direct contact.
Ambient Air Monitoring for Fugitive Dust	Collect real-time ambient particulate measurements at locations that are downwind of activities that have the potential to create fugitive dust. Collect samples at three to four locations on the landfill property line, three times each day during such activities (i.e., a total of 9 to 12 measurements per day).	To demonstrate compliance with the administrative rules promulgated pursuant to Part 55, Air Pollution Control, of the Natural Resources and Environmental Protection Act (NREPA).
Ambient Air Monitoring for VOCs	Collect VOC measurements with a photoionization detector (PID) during work at the landfill in which paper residuals will be exposed, at background locations, in the workers' breathing zone, and if necessary, at the downwind property line.	To determine if ambient VOC concentrations are at acceptable levels for compliance with the site health and safety plan.
Surface Water Monitoring	Record surface water turbidity concentrations at two locations, including an upstream location and a downstream location, during the placement of additional riprap along the riverbank.	To determine if the turbidity reading at the downstream location is within two times the result for the upstream location.
Landfill Gas Monitoring	Collect gas samples from six gas probes and 20 gas vents, and determine combustible gas, carbon dioxide, and oxygen concentrations. Pressure will also be recorded at the gas probes.	To demonstrate that combustible gas and other decomposition gases generated by the landfill are not traveling laterally from the landfill or accumulating within structures, and to demonstrate that the concentration of combustible gas is below the Lower Explosive Limit (LEL) at the property line.
	Assess nuisance odors at the property line.	To demonstrate that nuisance odors are not present at the property line.

Table 2-6 (continued)
Summary of Sample Types and Locations
(Remedial Action for the 12th Street Landfill)

Type of Sample	Assumed Location	Purpose
Groundwater Monitoring(2)	Collect groundwater samples from a total of seven shallow groundwater monitoring wells. Measure field parameters, including turbidity, temperature, pH, and conductivity.	To demonstrate compliance with the State of Michigan Part 201 groundwater–surface water interface (GSI) criteria (MDEQ, 2006), for those analytes specified in the ROD (Target Analyte List [TAL] inorganics, Target Compound List [TCL] organics, PCBs, and dioxins).

Note:
(1) The actual number of soil samples will be determined using a systematic random sampling strategy, following the MDEQ's S³TM guidance (see Section 6.1.2 of the Design Report [RMT, 2008] for a detailed discussion).
(2) See the groundwater monitoring plan in the Performance Standards Verification Plan (RMT, 2008) and Section 8.1 in the Design Report (RMT, 2008) for a detailed discussion of parameters, locations, and sampling frequency.



LEGEND

PROPERTY BOUNDARIES

N

0 1,000 2,000 4,000

FEET

1 INCH EQUALS 2,000 FEET

1:24,000

PROJECT LOCATION

BASE MAP FROM USGS 7.5 MINUTE QUADRANGLE, OSTEGO, 1967, REVISED 1973.

RMT

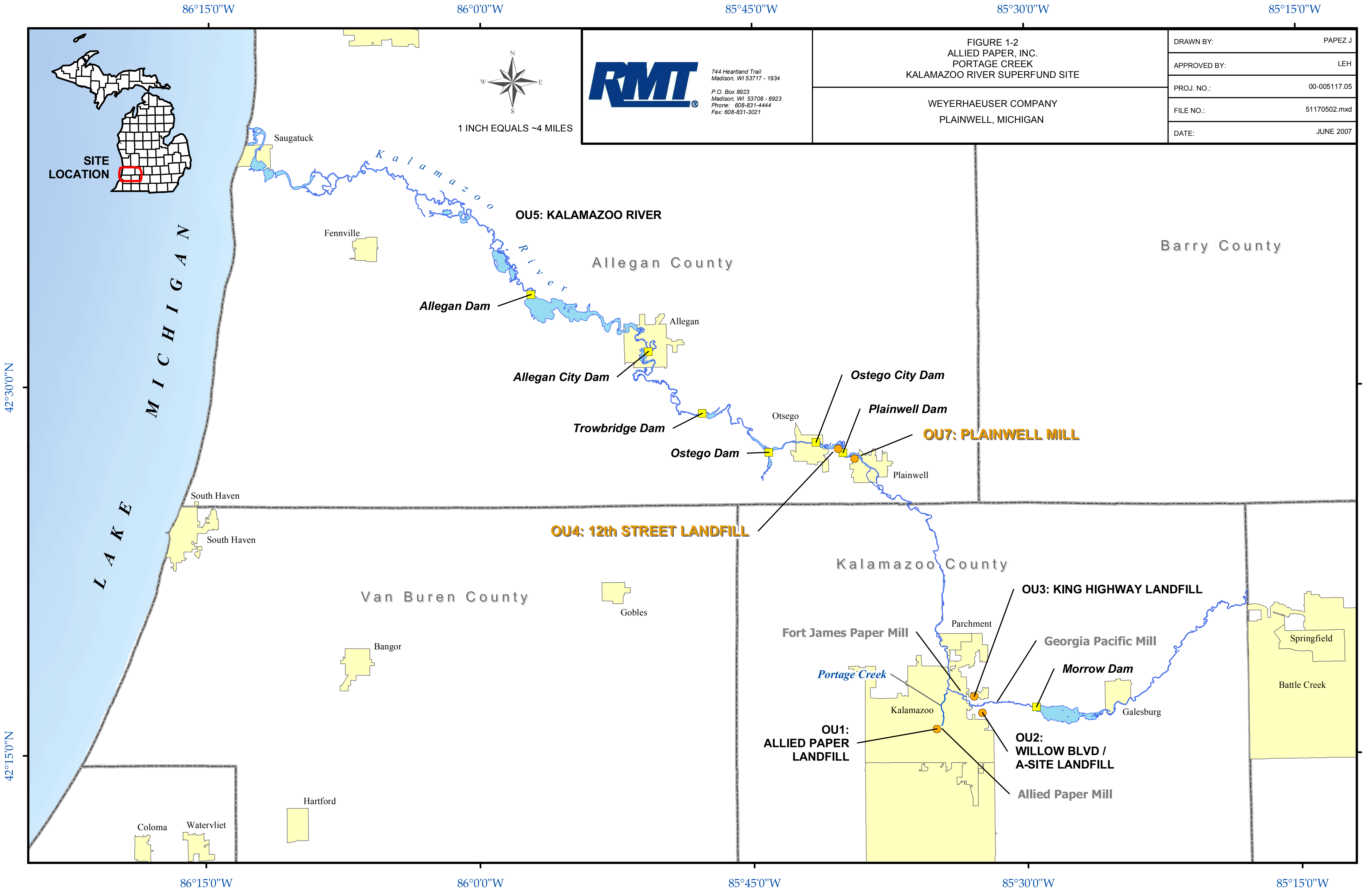
744 Heartland Trail
Madison, WI 53717 - 1934

P.O. Box 8923
Madison, WI 53708 - 8923
Phone: 608-831-4444
Fax: 608-831-3021

SITE LOCATION MAP

WEYERHAEUSER COMPANY
PLAINWELL, MICHIGAN

DRAWN BY:	PAPEZ J
APPROVED BY:	LEH
PROJ. NO.:	00-005117.05
FILE NO.:	51170501.mxd
DATE:	JUNE 2007



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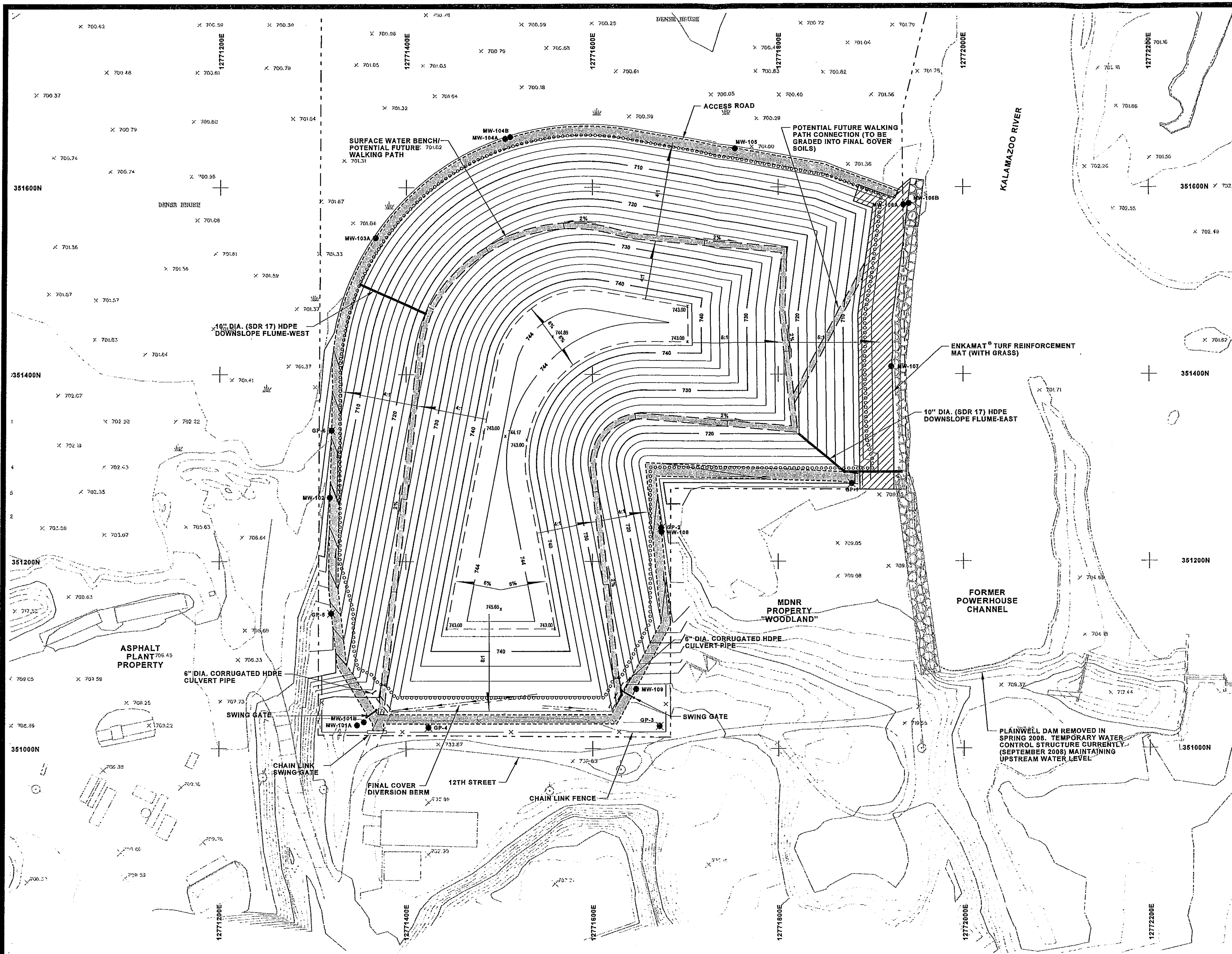


LEGEND

- APPROXIMATE PROPERTY BOUNDARY
- GRID LOCATION
- EXISTING PAVED ROAD
- EXISTING UNPAVED ROAD
- EXISTING BUILDING
- 700 EXISTING 10' CONTOUR
- EXISTING 2' CONTOUR
- x 715.1 EXISTING SPOT ELEVATION
- EXISTING WET AREA AND WETLAND
- EXISTING EDGE OF WATER
- EXISTING RIPRAP
- 740 PROPOSED 10' TOP OF FINAL COVER CONTOUR
- 738 PROPOSED 2' TOP OF FINAL COVER CONTOUR
- MW-1 PROPOSED GROUNDWATER MONITORING WELL
- GP-1 PROPOSED GAS PROBE LOCATION
- PROPOSED LIMITS OF PAPER RESIDUALS
- SURFACE WATER BENCH/POTENTIAL ECO-PARK WALKING TRAIL
- SITE ACCESS ROAD (GRAVEL)
- PROPOSED RIPRAP EXTENSION
- PROPOSED TURF REINFORCEMENT MAT
- x743.00 PROPOSED TOP OF FINAL COVER SPOT ELEVATION

NOTES

1. BASE TOPOGRAPHY PROVIDED BY OAS, INC. OF SEYMOUR, INDIANA BASED ON AERIAL SURVEY ON 3/30/2005. TOPOGRAPHY FOR THE EASTERN LANDFILL SIDESLOPE AND RIVERFRONT ADJACENT TO THE LANDFILL PROVIDED BY HOLLAND ENGINEERING, INC. SURVEY DATE: DECEMBER 6, 2007.
2. PROPERTY BOUNDARY BASED ON LEGAL DESCRIPTION PROVIDED BY THE U.S.EPA ON MARCH 30, 2004. COORDINATES FOR S 1/4 CORNER AND N 1/4 CORNER OF SECTION 24 AND NORTH BEARING USED TO PLOT PROPERTY LINE WERE PROVIDED BY HOLLAND ENGINEERING AND ARE BASED ON MICHIGAN STATE PLANE - SOUTH ZONE COORDINATES. THE VERTICAL DATUM IS NGVD 29.

0 50 100 150 200

SCALE 1"= 100 '

NOTE: THESE PLANS ARE ACCOMPANIED BY A REPORT OF THE SAME TITLE. THESE DOCUMENTS ARE INTERRELATED AND ARE INTENDED TO BE USED TOGETHER. THESE DOCUMENTS ARE INTENDED TO BE USED FOR REGULATORY PURPOSES ONLY.

NOT FOR CONSTRUCTION

NO.	BY	DATE	REVISION	APP'D.
3.				
2.				
1.				

PROJECT: **12TH STREET LANDFILL MULTI-AREA FIELD SAMPLING PLAN OTSEGO TOWNSHIP, MICHIGAN**

SHEET TITLE: **ENVIRONMENTAL MONITORING PLAN**

DRAWN BY: metza	SCALE: AS SHOWN	PROJ. NO. 5117.09	
CHECKED BY: ECW		FILE NO. ENV MON.PLT	
APPROVED BY: LEH	DATE PRINTED: OCT 08 2008	FIGURE 2-1	
DATE: OCTOBER 2008			

RMT 67

744 Heartland Trail
Madison, WI 53717-1934
P.O. Box 8923 53708-8923
Phone: 608.831.4444
Fax: 608.831.3334

Attachment A
Standard Operating Procedures

Table A-1
Standard Operating Procedures
Applicable for Corresponding Operable Units

SOP		Operable Unit
F-1	Water Sampling and Field Measurement Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-2	Surface Water Flow Measurement Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-3	Water Treatment System Monitoring Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-4	Sediment Sampling	Operable Unit No. 5 – Kalamazoo River
F-5	Soil Sampling with Direct Push Sampler	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-6	Surficial Soil Sampling	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-7	Landfill Gas Monitoring	Operable Unit No. 4 – 12th Street Landfill site
F-8	Excavation of Test Pits and Test Pit Soil Sampling	Operable Unit No. 7 – Plainwell Mill site
F-9	Photoionization Detector (PID) Screening	Operable Unit No. 7 – Plainwell Mill site
F-10	Staff Gage Installation and Measurement	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 5 – Kalamazoo River Operable Unit No. 7 – Plainwell Mill site
F-11	Groundwater Sampling and Field Measurement Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-12	Ambient Air Monitoring for Fugitive Dust	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-13	Ambient Air Monitoring for VOCs	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-14	Real-Time Turbidity Measurement Procedures for Surface Water	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site
F-15	Monitoring Well Installation Procedures	Operable Unit No. 4 – 12th Street Landfill site Operable Unit No. 7 – Plainwell Mill site

Standard Operating Procedure F-1
Water Sampling and Field Measurement Procedures

This standard operating procedure (SOP) sets forth the field procedures for the collection of water column samples via boat, sampling from shore, or sampling from a bridge. Water column samples will be collected using a stainless steel Kemmerer water sampler, utilizing a peristaltic pump with Teflon tubing, or using an ISCO automated sampler. Samples collected downstream of construction to monitor TSS and PCB transport will utilize an ISCO automated sampler. Treated water from construction activities will be obtained using a direct grab sampling method.

Decontamination Procedures for Nondedicated Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

The submersible pumps are not designed to withstand acid rinsing. Decontamination of this equipment will therefore consist of washing the downhole portions of the equipment with nonphosphate detergent and rinsing with DI or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment is included in the sampling procedures described below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Water Column Sampling Procedures

Water column samples will be collected using a stainless steel Kemmerer water sampler, a peristaltic pump with Teflon tubing, or a discrete grab sample in appropriate sample containers. The sample collection method will be determined based on river flow, water depth, and site conditions at the time of collection. The Kemmerer sample collection device is lowered to the appropriate sample depth on a cable in an open position and a weighted messenger is sent along the cable to trip the sampler closed. The peristaltic pump with disposable silicone pump tubing and Teflon sample tubing is lowered to depth and directly pumps water from the river. Grab sample collection is utilized for shallow water river conditions or when collecting water out of a sample port for water treatment system evaluation.

Prior to initiating field activities, the water quality meter will be calibrated according to the manufacturer's instructions and the calibration data recorded in the logbook or on the Water Quality Meter Calibration Log. The procedures for collection of water column samples are provided below.

1. Record the sample location on the sample log or in field notebook along with other appropriate information [include a sketch indicating location relative to shore features, if appropriate].
2. Don health and safety equipment (as required by the Multi-Area HSP).
3. Decontamination of the sampling equipment prior to initial use, between sampling at each transect, and at the completion of sampling as follows: distilled water rinse; acetone rinse; hexane triple rinse; and distilled water triple rinse. All decontamination rinsate water will be contained in a MDOT-approved container. If using a peristaltic pump with disposable tubing or a discrete grab sample into appropriate lab supplied glassware, no equipment cleaning is needed.
4. Prepare one rinse-blank sample prior to and after sampling activities, by pouring deionized water supplied by the laboratory through the cleaned Kemmerer and filling the sample containers as described in Steps 8 and 9. If a peristaltic pump and Teflon tubing or a discrete grab sample is used, no rinse blanks are required.
5. Measure the total depth of the water column. Initial field checks with a survey rod will be performed to confirm accuracy.
6. Lower the water sampler to 0.8 times the total water column depth and either release the trigger on the Kemmerer, start peristaltic pump, or lower sample bottle.
7. Raise the water sampler from the water column with minimal disturbance, continue to pump river water, or secure grab sample jars.
8. Remove the covers from the appropriate laboratory supplied containers and slightly tilt the mouth of the container below the sampling device.
9. Empty the sampler slowly, allowing the sample stream to flow gently down the side of the sample container (with minimal entry turbulence).

10. Repeat Steps 6 through 9 for collection of sample at 0.2 times the total water column depth.
11. Repeat Steps 5 through 10 at the other river locations.
12. At each station, collect field measurements for temperature, pH, turbidity, conductivity, and DO at 0.2 and 0.8 times the total water column depth record results on the appropriate in the field logbook or Surface Water Sampling Log.
13. Secure all sample jar caps tightly.
14. Label all sample containers.
15. Place filled sample containers on ice in a cooler.
16. Collect field duplicate and matrix spike (MS) and matrix spike duplicate (MSD) samples during each sampling event. Field duplicates and MS/MSD samples will be prepared by filling additional sets of sample containers with water collected at the same time and depth. One additional set of sample containers will be filled for field duplicates and two sets of containers will be filled for MS/MSD samples.
17. Follow procedures for preservation of samples and packing, handling, and shipping with associated chain-of-custody procedures for samples
18. Record required information in the field logbook or Surface Water Sampling Log.

Continuous Water Column Sampling Procedures During Construction

Three movable YSI Sonde units, each equipped with probes to measure dissolved oxygen, turbidity, pH, conductivity, and temperature will be used upstream and two locations downstream of the construction area. The YSI logs the above data at predetermined time intervals. The unit will be programmed to sample hourly during construction operations. The data will be downloaded daily onto a computer hard drive for backup.

Calibration Procedures - The YSI will be calibrated weekly in accordance with manufacturer's instructions. Calibration information will be recorded in the field logbook.

Operation Procedures - The YSI will be operated according to the manufacturer's instructions.

Maintenance Procedures - The YSI will be maintained according to the manufacturer's instructions. Maintenance information will be recorded in the field logbook. A replacement meter and probes will be available onsite or ready for overnight shipment, as necessary.

The units will be placed within a perforated PVC pipe for protection and anchored to the river bottom. A buoy will be attached to the PVC pipe for accessibility, and the unit attached to shore for security. In addition to the Sonde units, a sampling line will also connected to tubing which feed to an ISCO sampler located on shore for discreet sampling of the water throughout the construction activities. Samples will be taken every 15 minutes during material placement.

The water sample that corresponds to the highest turbidity reading over the placement period should be submitted to WATS laboratory for analysis of Total Suspended Solids (TSS), Volatile Suspended Solids (VSS) and polychlorinated biphenyls (PCBs).

Collection Procedures - The procedures for collection of water column samples using the YSI and ISCO sampler are provided below.

1. Record the sample location on the sample log or in field notebook along with other appropriate information [include a sketch indicating location relative to shore features, if appropriate].
2. Measure the total depth of the water column at mid-river location using a portable depth finder. Initial field checks with a survey rod will be performed to confirm accuracy.
3. Place Sonde unit and ISCO intake tubing at a mid-river location, if possible. Attach the tubing to the upstream side of the monitoring using cable ties. Depending upon site conditions, placement of a station at mid-river may not be safe or feasible. In this event, water samples may be collected from a pier or boat.
4. Set the ISCO composite sampler and portable power source on shore and attach to an immovable object (tree, fence, etc) to deter theft/vandalism.
5. Place necessary glassware in the sampler and surround glassware with up to 20 pounds of ice.
6. Attach the intake tubing to the tubing in the pump head. Ensure that the tubing slopes downhill from the pump head to the intake point to ensure draining between sampling events.
7. Program the sampler according the manufacturers instructions including two rinse cycles prior to collection. Set the appropriate sample time and volume to fill an individual container. Ensure that the sampler is in “Run” mode prior to leaving the sampler. Close the top of the sampler for protection against the elements.
8. Retrieve the sample containers from the ISCO sampler upon completion of the timed sampling event.
9. Download the information from the Sonde unit for the timed sampling event.
10. Match the highest turbidity readings from the Sonde unit with the corresponding ISCO sample.
11. Remove the covers from the appropriate laboratory supplied containers and slightly tilt the mouth of the container below the ISCO sample container.
12. Empty the sample container slowly, allowing the sample stream to flow gently down the side of the laboratory supplied sample container (with minimal entry turbulence).
13. Secure all sample jar caps tightly.
14. Label all sample containers.
15. Place filled sample containers on ice in a cooler.
16. Collect field duplicate and matrix spike (MS) and matrix spike duplicate (MSD) samples during each sampling event or as required. Field duplicates and MS/MSD samples will be prepared by filling additional sets of sample containers with water collected at the same time and depth. One additional set of sample containers will be filled for field duplicates and two sets of containers will be filled for MS/MSD samples.
17. Follow procedures for preservation of samples and packing, handling, and shipping with associated chain-of-custody procedures for samples.

18. Record required information on the field logbook or Surface Water Sampling Log.
19. Follow appropriate decontamination procedures describe above for the sample equipment as necessary.

Standard Operating Procedure F-2
Surface Water Flow Measurement Procedures

This standard operating procedure (SOP) describes the field procedures for determining surface water flow at a river transect. In general, these procedures include dividing the width of the channel conveying flow into segments and measuring the average velocity and cross-sectional area of each segment. The total flow is then calculated as the sum of the product of average flow velocity and cross-sectional area of each segment.

Decontamination Procedures for Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

The submersible pumps are not designed to withstand acid rinsing. Decontamination of this equipment will therefore consist of washing the downhole portions of the equipment with nonphosphate detergent and rinsing with DI or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment is included in the sampling procedures described below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Surface Water Flow Measurement Procedures

The general procedures to be followed when obtaining surface water flow measurements at a river or creek transect are described below.

The following materials will be available, as required, during water column sampling:

- health and safety equipment to be worn when working around surface water, as described in the Multi-Area Health and Safety Plan (HSP)
- field notebook and pen
- calculator
- rope
- survey rod
- duct tape
- 200-foot measuring tape
- electromagnetic velocity meter

Surface Water Flow Measurement Sampling Procedures

The following procedures will be used to determine the velocity profile at a cross-section:

1. Measure the width of the water body, then divide and mark into equally spaced measurement locations. For water bodies less than 30 feet in width, the spacing should be 5 feet. For water bodies between 30 feet and 100 feet in width, the spacing should be 10 feet. For water bodies greater than 100 feet in width, the spacing should be 20 feet.
2. Calibrate the velocity meter according to manufacturer's specifications.
3. Lower the survey rod and measure and record the water depth to the nearest 0.1 foot at each measurement location in the field logbook or on the Velocity Profile Measurement Log. Measurements should be collected at the center of each 5-foot (or 10- or 20-foot) increment.
4. Velocities will be determined using the two-point method. Attach the velocity meter probe to the survey rod, measure and record the velocity in feet per second at depths equaling 0.2 and 0.8 times the total depth at each measurement location. Average the two velocity measurements to obtain the average velocity for that vertical section. Record all measurements in the field logbook or on the Velocity Profile Measurement Log.

5. Calculate the average total flow by multiplying the average velocity reading times the cross-sectional area of the 5-foot (or 10- or 20-foot) increment. The cross-sectional area is determined by multiplying the width of the increment (*i.e.,* 5, 10, or 20 feet) times the average water depth within that increment. The total flow is the sum of the velocity times the area for each increment and can be calculated using the following formula:

$$QT = V1\ A1 + V2\ A2 + ... + Vn\ An$$

where:

QT = Total flow in cubic feet per second

V1-n = Average velocity for a vertical section (feet per second)

A1-n = Cross-sectional area of each increment (square feet)

6. For flow measurements at bridges, water surface will be measured using a weighted rope or tape measure as a "tape down" distance from a distinct reference point on the bridge.
7. Surface water flow measurement locations and "tape down" locations will be recorded in a field notebook sketch as appropriate.
8. Conduct appropriate decontamination procedures described above.

Standard Operating Procedure F-3
Water Treatment System Monitoring Procedures

This standard operating procedure (SOP) describes the field procedures for collection of in-field water treatment system measurements including grab samples for PCB analysis at the influent, intermediate stage and effluent of the water treatment system, grab samples for TSS at the effluent of the water treatment system and grab samples for phosphorus at the effluent of the water treatment system.

Decontamination Procedures for Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Water Treatment System Monitoring Procedures

Grab samples of surface water will be collected at a specified frequency during the response activities for PCB analysis. Surface water samples will be collected from the influent, at the intermediate stage and at the effluent of the water treatment system. Surface water grab samples will be collected at the effluent of the water treatment system for phosphorus and TSS monitoring at a specified frequency during the response activities. Turbidity measurements will also be collected during the water treatment system operation activities. The general procedures to be followed when the surface water grab samples are collected or measurements taken are outlined below. Specific analytical methods are described in the QAPP.

The procedures for collection of water treatment system grab samples are provided below.

1. Record the surface water grab sample location (*i.e*. effluent, influent) on the sample log or in field notebook along with other appropriate information [include a sketch indicating location of sample relative to the water treatment system].
2. Don health and safety equipment (as required by the Multi-Area HSP).
3. Collect the grab samples by quickly immersing the specified sample container with the mouth of the container pointing towards the influent.
4. Raise the sample jar from the water with minimal disturbance and secure the jar.
5. At each station, collect field measurements for temperature, pH, turbidity, conductivity, and DO and record results in the field logbook or Surface Water Sampling Log.
6. Secure all sample jar caps tightly.
7. Label all sample containers.
8. Place filled sample containers on ice in a cooler.
9. Collect field duplicate and matrix spike (MS) and matrix spike duplicate (MSD) samples during each sampling event. Field duplicates and MS/MSD samples will be prepared by filling additional sets of sample containers with water collected at the same time and depth. One additional set of sample containers will be filled for field duplicates and two sets of containers will be filled for MS/MSD samples.
10. Follow procedures for preservation of samples and packing, handling, and shipping with associated chain-of-custody procedures for samples.
11. Follow appropriate decontamination procedures described above.
12. Record required information in the field logbook or Surface Water Sampling Log.

Standard Operating Procedure F-4
Sediment Sampling

This standard operating procedure (SOP) is applicable to the collection of representative sediment samples. The methodologies discussed in this SOP are applicable to the sampling of sediment in both flowing and standing water. They are generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, sediments are those mineral and organic materials situated beneath an aqueous layer.

Method Summary

Sediment samples may be collected using a variety of methods and equipment, depending on the depth of the water, the portion of the sediment profile required (surface vs. subsurface), the type of sample required (disturbed vs. undisturbed), contaminants present, and sediment type. Sediment is collected from beneath the water either directly, using a hand held device such as a shovel, trowel, or auger; or indirectly, using a device such as an Ekman or Ponar dredge. Following collection, sediment is transferred from the sampling device to a sample container of appropriate size and construction for the analyses requested. If composite sampling techniques are employed, multiple grabs are placed into a container constructed of inert material, homogenized, and transferred to sample containers appropriate for the analyses requested.

Equipment/Apparatus

Equipment needed for collection of sediment samples may include:

- Maps/plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags, or buoys and anchors
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels

- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel
- Bucket auger
- Tube auger
- Extension rods
- "T" handle
- Sediment coring device (tube, suction head, extension rods, "T" handle)
- Ponar dredge
- Ekman dredge
- Nylon rope or steel cable
- Messenger device

Decontamination Procedures

Decontamination Prior to Sampling

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

In-Field Sampling Decontamination Procedures

As described above, this sampling protocol describes multiple methods for sediment sample collection. The decontamination procedures described below will be relied upon in the field as appropriate for equipment decontamination.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment is included in the section below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

Sample Collection

Selection of a sampling device is most often contingent upon: 1) the depth of water, and 2) the physical characteristics of the sediment to be sampled. The following procedures may be utilized:

Sampling Surface Sediment with a Trowel or Scoop

The sampling method is accomplished by wading into the surface water body and while facing upstream (into the current), scooping the sample along the bottom of the surface water body in the upstream direction. Excess water may be removed from the scoop. However, this may result in the loss of some fine particle size material associated with the bottom of the surface water body.

This method can be used to collect consolidated sediments but is limited somewhat by the depth of water. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. In surface water bodies that are too deep to wade, but less than eight feet deep, a stainless steel scoop or spoon attached to a piece of conduit can be used either from the banks if the surface water body is narrow or from a boat. The sediment is placed into a glass pan and homogenized.

A stainless steel scoop or lab spoon will suffice in most applications. Follow these procedures to collect sediment samples with a stainless steel scoop:

1. Using a precleaned stainless steel scoop, remove the desired thickness of sediment from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container.

Sampling Surface Sediment with a Bucket Auger or Tube Auger

This system consists of an auger, a series of extension rods, and a "T" handle. The auger is driven into the sediment and used to extract a core. A sample of the core is taken from the appropriate depth.

Use the following procedure to collect sediment samples with a thin-walled auger:

1. Insert the auger into the material to be sampled at a 0^{o} to 45^{o} angle from vertical. This orientation minimizes spillage of the sample from the sampler. Extraction of samples may require tilting of the sampler.
2. Rotate the auger once or twice to cut a core of material.
3. Slowly withdraw the auger, making sure that the slot is facing upward.
4. An acetate core may be inserted into the auger prior to sampling, if characteristics of the sediments or body of water warrant. By using this technique, an intact core can be extracted.
5. Transfer the sample into an appropriate sample or homogenization container.

Sampling Surface Sediment with a Ponar Dredge

The Ponar dredge uses a self-tripping sampler featuring hinged jaws and a spring loaded pin that releases when the sampler makes impact with the bottom. The top is covered with a stainless steel screen with neoprene rubber flaps which allows water to flow through for a controlled descent and less interference with the sample.

Follow these procedures for collecting sediment with a Ponar dredge:

1. Attach a sturdy nylon or steel cable to the hook provided on top of the dredge.
2. Arrange the Ponar dredge sampler in the open position, setting the trip bar so the sampler remains open when lifted from the top.
3. Slowly lower the sampler to a point just above the sediment.
4. Drop the sampler sharply into the sediment, then pull sharply up on the line, thus releasing the trip bar and closing the dredge.
5. Raise the sampler to the surface and slowly decant any free liquid through the screens on top of the dredge. Be careful to retain fine sediments.
6. Open the dredge and transfer the sediment to a stainless steel or plastic bucket. Continue to collect additional sediment until sufficient material has been gained. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample container.

Sampling Subsurface Sediment with a Coring Device

Core samplers are used to sample vertical columns of sediment. They are particularly useful when a historical picture of sediment deposition is desired since they preserve the sequential layering of the deposit, and when it is desirable to minimize the loss of material at the sediment-water interface.

Follow these procedures when using a sample coring device to collect subsurface sediments. It consists of a coring device, handle, and acetate core barrel:

1. Assemble the coring device by inserting the core into the sampling tube assembly.
2. Insert the "vacuum plug" into the tip of the sampling tube with the wire connected through the top portion of sampling equipment.
3. Tighten the plug so the fit is snug within the tube.
4. Tighten the rubber fitting, associated with the sampling equipment, around the top end of the tube.
5. Screw the handle onto the upper end of the sampling tube and add extension rods as needed.
6. Place the sampler in a perpendicular position on the material to be sampled.
7. With left hand holding the wire (connected to the plug inside the core assembly), place downward pressure on the sampler into the material to the desired depth. Do not allow the plug to proceed deeper (hold left hand at constant elevation, while advancing core with right hand).
8. Place downward pressure on the device until the desired depth is reached.
9. Withdraw the sampler by puling the sampling assembly upwards, until the bottom of the core can be reached below the surface of the water.
10. Place cap on core, while end of the core is still underneath the water's surface.
11. Remove core from water and loosen rubber fitting.
12. Remove core from sampling equipment and place an additional cap on top of core (it may be appropriate to reduce the core length prior to capping the core).
13. The sample may be used in this fashion, or the contents transferred to a stainless steel or plastic bucket and mixed thoroughly to obtain a homogeneous sample representative of the entire sampling interval.

Sediment Probing and Bathymetric Survey

The metal calibration rod will be used to probe sediment depths along the sediment characterization transects. From a boat, at each station, the water depth to top of sediment will be measured by probing with a surveyor's rod. The sediment depth will then be measured by pushing a calibrated 5/8-inch galvanized hollow pipe into the sediment until refusal using reasonable human force. The depth of the penetrated sediment will be noted by subtracting the length of the rod above the water surface and the water depth at the point being probed from the length of the entire rod. Measurements made of location, depth, time, and field samples will be noted by subtracting the length of the rod above the water surface and the water depth at the point being probed from the length of the entire rod. Measurements made of location (using a GPS unit, if applicable), depth, time, and field samples will be noted in the field logbook.

References

Mason, B.J. Preparation of Soil Sampling Protocol: Technique and Strategies. 1983 EPA-600/4-83-020.

Barth, D.S. and B.J. Mason. Soil Sampling Quality Assurance User's Guide. 1984 EPA-600/4-84-043.

U.S. EPA. Characterization of Hazardous Waste Sites - A Methods Manual: Volume II. Available Sampling Methods, Second Edition. 1984 EPA Hazardous Waste Streams. 1980 EPA-600/2-80-018.

Field Sampling Guidance Document #1215 – Sediment Sampling, U.S. EPA Region 9 Laboratory Richmond California. 1999.

Sediment Sampling SOP #2016. U.S. EPA. 1994.

Standard Operating Procedure F-5
Soil Sampling with Direct Push Sampler

The primary means for the collection of subsurface soil samples will be a direct-push technique using a Geoprobe® or equivalent driver. Direct-push soil samples will be obtained using a closed-piston soil sampler with a liner (or equivalent sampling system). The Sampler will be operated in accordance with the manufacturer's recommended operating procedures for the type of equipment used.

Soil samples will be collected at predetermined intervals based on specific data needs. The samples will be classified in accordance with the Unified Soil Classification System (USCS), and field logs will be prepared. A summary of the USCS is attached to this procedure.

Small subsamples representative of the major soil types will be retained for use in developing visual classification as described later in this subsection, and for physical testing, as required.

Subsamples selected for laboratory analysis will be placed in appropriate sample containers provided by the analytical laboratory, labeled, placed in an iced cooler, and stored in accordance with chain-of-custody requirements specified in the QAPP until shipment to the laboratory (or laboratories) is arranged. Chain-of-Custody Records will be completed for all samples according to the methods described in the QAPP.

Geoprobe® and support equipment will not come in direct contact with the samples, so cross-contamination of samples is not a concern. However, this equipment will likely come in contact with impacted soil and must therefore be decontaminated prior to moving from one location to another.

The Geoprobe® equipment used for soil sampling and monitoring well installation will be cleaned with high-pressure/hot water washing equipment prior to initiating the field investigation. The same procedure will be applied to all drilling equipment between each boring location. The cleaning will occur at a decontamination pad constructed at a suitable location(s) at the site. Water used for cleaning will be obtained from a local potable water source. Equipment subject to these decontamination procedures includes, but is not limited to, the following:

- Direct Push drill rig
- Direct Push sampler components

In addition, downhole equipment that comes in direct contact with samples will be decontaminated between each sample interval. This procedure will include washing with a nonphosphate detergent and rinsing with clean potable water.

A piece of Direct Push equipment that comes in direct contact with soil samples (*e.g.,* split-barrel samplers) will be selected for collection of one field equipment blank. After the equipment has been cleaned, it will be rinsed with DI water. The rinse water will be collected and submitted for analysis of all constituents for which the normal samples collected with the equipment are being analyzed.

Standard Operating Procedure F-6
Surficial Soil Sampling

This standard operating procedure (SOP) is applicable to the collection of representative soil samples. The methodology is generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, soils are those mineral and organic materials not submerged in water for an extended period of time sufficient to support aquatic life.

Equipment/Apparatus

Equipment needed for collection of soil samples may include:

- Maps/Plot plan
- Safety equipment
- Compass
- Tape measure
- Survey stakes, flags,
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel

Decontamination Procedures

Decontamination Prior to Sampling

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

In-Field Sampling Decontamination Procedures

As described above, this sampling protocol describes multiple methods for soil sample collection. The decontamination procedures described below will be relied upon in the field as appropriate for equipment decontamination.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment are included in the section below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

Sample Collection

Sampling Surface Soil with a Trowel or Scoop

The sampling method is accomplished by scooping the soil sample along the top 6 inches of the surface with a stainless steel scoop. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. Once collected, the sample is placed in a glass or stainless still bowl and homogenized.

A stainless steel scoop or lab spoon will suffice in most applications. Follow these procedures to collect soil samples with a stainless steel scoop:

1. Using a precleaned stainless steel scoop, remove the desired thickness of soil from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container.

Standard Operating Procedure F-7
Landfill Gas Monitoring

This standard operating procedure (SOP) is applicable to landfill gas monitoring. The methodology is generic in nature and may be modified in whole or in part to meet the constraints presented by site conditions and equipment limitations. Modifications of monitoring methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and monitoring results.

Equipment

Equipment needed for landfill gas monitoring may include the following:

- Portable combustible gas meter
- Pressure gauges with varying sensitivity ranges
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

The gas composition will be monitored in groundwater monitoring wells, Geoprobe® borings, gas vents, or gas probes using a portable combustible gas meter (e.g., a Landtec®, or equivalent). The instrument selected will directly analyze the gas for methane, carbon dioxide, and oxygen (as percent by volume). Although nitrogen is not read directly, it can be calculated in the following manner:

$$\text{Balance gas} = 100\% - (\%CH_4 + \%CO_2 + \%O_2)$$

The balance gas represents the nitrogen content of the gas, as the trace gases typically make up much less than 1 percent of the total gas collected.

In addition, pressure will be measured at gas probes or groundwater monitoring wells, using a pressure gauge (a Magnehelic®, or equivalent) with the appropriate sensitivity range to obtain an accurate pressure reading, to determine if excess landfill gas is contributing to excess pressure.

Operational Procedures

The portable combustible gas meter and pressure gauges will be operated according to the manufacturers' instructions. A summary of the operational procedures that will be used for the portable combustible gas meter and pressure gauges (*i.e.,* calibration and monitoring procedures) is provided below.

General Information

On each day that landfill gas monitoring is being performed, record the following general information:

- Date
- Weather conditions
- Barometric pressure and trend
- Temperature
- Ground condition (saturated, frozen, etc.)
- Names of personnel performing the monitoring

Meter Calibration

Prior to initiating gas monitoring, the portable combustible gas meter will be calibrated in an area where the ambient concentrations of gases of concern are not present. The oxygen sensor and methane sensor will be calibrated in accordance with the manufacturer's recommended procedures.

The pressure gauges are calibrated by the manufacturer and do not require field calibration. Prior to measuring pressures, the appropriate pressure gauge will be selected (*i.e.,* the gauge with the appropriate sensitivity range to obtain an accurate pressure reading), and the pressure gauge will be set to zero, to the extent possible. If the pressure gauge cannot be set precisely to zero prior to monitoring, the initial reading will be noted and subtracted from the measured reading.

Landfill Gas Monitoring at Gas Vents, Gas Probes, or Groundwater Monitoring Wells (Pressure and Composition)

If sampling gas probes or vents, the probes or vents will be installed with sampling ports. If sampling groundwater monitoring wells, the wells will be retrofitted with a sampling port. The sampling port will include a labcock valve (or equivalent), which will be used to connect the portable combustible gas meter. For gas probes or groundwater monitoring wells, the sampling will also be used to connect the pressure gauge (or gauges, if appropriate).

The following procedures will be followed to monitor the gas composition and gauge pressure (if present):

Pressure

1. Attach the low-pressure port of the pressure gauge to the monitoring port using silicone tubing. Open the labcock valve, record the pressure, and then close the labcock valve. If the gauge indicates a negative reading, switch the tubing on the gauge to the high-pressure sampling port and repeat the previous steps.

Gas Composition

1. Attach the portable combustible gas meter to the monitoring port using silicone tubing. Engage the internal pump of the combustible gas meter, and open the labcock valve. When the readings stabilize, record the concentrations and close the labcock valve.
2. After each reading using the portable combustible gas meter, remove the tubing from the monitoring port and allow the methane and carbon dioxide readings to return to zero.

Landfill Gas Monitoring at Geoprobe® Boreholes (Composition)

The following procedures will be followed to measure the gas composition within Geoprobe® borings:

1. After reaching the desired vertical depth with the Geoprobe® rods, retract the rods approximately 1 foot to disengage the expendable drive point.
2. Push the Post-Run Tubing (PRT) adapter into the landfill gas sampling tubing. Insert the adapter end of the tubing down the inside of the probe rods until it hits the bottom on the expendable drive point holder.
3. Turn the tubing in a counterclockwise direction, and apply slight downward pressure to engage the adapter threads with the expendable drive point holder.
4. Connect the outer end of the tubing to a silicone tubing adapter (if needed) or directly to the portable combustible gas meter. Engage the internal pump of the combustible gas meter, and purge the tubing for a minimum of 1 minute prior to recording and/or measuring the landfill gas concentrations (methane, oxygen, and carbon dioxide). When the readings stabilize, record the concentrations.

Maintenance Procedures

The portable combustible gas meter and pressure gauges will be maintained according to the manufacturers' instructions. A replacement meter and/or gauges will be ready for overnight shipment, if needed.

Standard Operating Procedure F-8: Excavation of Test Pits and Test Pit Soil Sampling

This standard operating procedure (SOP) is applicable to the excavation of test pits and the collection of soil samples from the test pits. The methodology is generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, soils are those mineral and organic materials not submerged in water for an extended period of time sufficient to support aquatic life.

Equipment/Apparatus

Equipment needed for excavation of test pits and the collection of test pit soil samples may include:

- Excavation equipment (*e.g.,* backhoe)
- Hand augers
- Spade or Shovels
- Maps/plot plan
- GPS
- Safety equipment
- Tape measure
- Survey stakes, flags,
- Camera and film
- Stainless steel, plastic, or other appropriate composition bucket
- 4-oz., 8-oz., and one-quart wide mouth jars w/Teflon lined lids
- Ziploc plastic bags
- Logbook
- Sample jar labels
- Chain of Custody records, field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Spatula
- Stainless Steel Scoop
- Plastic or Stainless Steel Spoons
- Trowel

Decontamination Procedures

Decontamination Prior to Sampling

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.
3. Rinse with deionized (DI) or distilled water.

In-Field Sampling Decontamination Procedures

As described above, this sampling protocol describes multiple methods for excavation of test pits and collection of soil samples from test pits. The decontamination procedures described below will be relied upon in the field as appropriate for equipment decontamination.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment are included in the section below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Attachment 7 (MDEQ, 2004).

The field decontamination of the excavation equipment (backhoe) will take place on a specified decontamination area. Equipment used to excavate the test pits will be decontaminated following completion of each test pit Decontamination of the excavator bucket will consist of removing remaining soil at the test pit location. The backhoe will then move to the decontamination area and the bucket washed with decontamination water. The decontamination water will be collected and containerized in 55-gallon barrels that will be properly labeled and temporarily stored on-site. A sample of the decontamination water will be collected and analyzed for the parameters required by a permitted off-site disposal facility. Following receipt of the analytical results, the decontamination water will be transported and disposed at the off-site facility. Documentation of off-site disposal activities will be included in the Remedial Investigation Report. Final decontamination of the backhoe bucket and tires will be performed prior to the equipment leaving the site.

The field decontamination of soil sampling equipment (stainless steel scoops, etc.) will take place at the sampling location or decontamination area. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination area for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Attachment 7 (MDEQ, 2004).

Test Pit Excavation Procedures

Prior to initiation of the excavation activities, a kick-off meeting with the field representatives will be conducted. The health and safety guidelines will be discussed during the meeting. Additional information regarding health and safety measures is included in the Health and Safety Plan prepared in conjunction with the Remedial Investigation. All sampling locations will be clear of any overhead or identified buried utility.

Test pits will be excavated using a backhoe or other appropriate equipment at approximate locations according to the sampling plan. In the event that in-field conditions limit the use of excavation equipment, hand augers or shovels may be used. Test pit locations will be identified in the appropriate project workplan. Test pits will not be located immediately adjacent to the waterways (e.g. Kalamazoo River) or rip rap present along the banks in order to maintain the current containment. Appropriate spill containment and control measures will be implemented at each test pit location. Spill kits will be available on site for immediate deployment if needed according to the site specific Spill Response Contingency Plan.

Depending upon conditions the size of test pits can have a wide range. Typically test pits are anticipated to be approximately 5 to 15 feet long and approximately 2 to 4 feet wide. The text pits will be excavated to a depth of 3 to 12 feet depending on field conditions. In general, test pits are placed to a depth to either intersect the groundwater table or to natural soils. Test pits may be excavated to a greater depth if conditions warrant and all visual observations will be documented. Test pits may be used to identify free product or oil saturated soil for PCB investigations. The test pits will be logged according to the Unified Soil Classification System by the on-site field geologist or engineer.

At a minimum, field logs for the test pits will include the following documentation:

1. Plan and profile sketches of the test pit showing materials encountered, the depth of material, and sample locations
2. Sketch of the test pit and distance and direction from permanent, identifiable location marks as appropriate.
3. A description of the material removed from the excavation
4. A record of samples collected

5. The presence or absence of water in the test pit and the depth encountered
6. Other readings, or measurements taken during excavation, including field screening reading

Unless otherwise specified and the site-specific Health and Safety Plan discusses appropriate procedures, no personnel will enter the test pit. In addition, all test pits will be backfilled on the day of excavation. In most cases, excavation materials will be used to fill the test pit. In the event that highly contaminated soil is encountered, excavated soils may be stockpiled on polypropylene or placed within lined dumpsters and the excavation will be filled with clean soil.

Test Pit Soil Sample Collection

Sampling Surface Soil from a Test Pit

The sampling method is accomplished by scooping a representative soil sample of the excavated soil from the backhoe bucket with a stainless steel scoop. Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by the sample team member. Once collected, the sample is placed in a glass or stainless steel bowl and homogenized. Samples will be collected and analyzed for PCBs and total petroleum hydrocarbons. Other select analysis will be performed based upon visual and olfactory conditions observed in the test pits. Samples will also be screened with a photoionization detector (PID) following procedures presented in SOP-8.

A stainless steel scoop or lab spoon will be used for sampling in most applications. Follow these procedures to collect soil samples with a stainless steel scoop:

1. Using a precleaned stainless steel scoop, remove the desired thickness of soil from the sampling area.
2. Transfer the sample into an appropriate sample or homogenization container.

Samples will be visually classified for soil types in the field and screened with a photoionization detector (PID). Selected samples with elevated PID readings or the presence of industrial fill material will be submitted for analysis of PAHs, VOCs and/or metals. The selection of samples to submit for analysis will utilize a biased sampling approach that will rely on a variety of specific site observations including:

- visible residuals;
- visible petroleum impacts;
- PID readings greater than a baseline of 10 ppm above background ambient air readings which will be taken on site beyond the influence of exhaust from equipment;
- notable odors; and
- soil stratigraphy.

The number of samples collected for analysis from each test pit is also dependent upon specific observations made during the test pit excavations. A minimum of one sample per test pit will be collected and analyzed for PCBs and total petroleum hydrocarbons. This sample will be taken at one of several locations:

- From unsaturated soil just above the saturated soil zone as evidenced by the visible presence of groundwater
- From the center bottom of the test pit if there is no groundwater visible

If observed conditions in the test pit warrant collection of additional samples, a total of up to three soil samples may be collected within a single test pit and analyzed for selected parameters based upon visible conditions. Samples will be collected for analysis based upon several possible test pit conditions including:

- Changes in fill or soil types
- Modifications in soil color or soils with noticeable odors
- Presence of free product
- Extended size of the test pit that needs additional characterization

Standard Operating Procedure F-9
Photoionization Detector (PID) Screening

This standard operating procedure (SOP) is applicable to the use of a PID/FID instrument during in-field soil sampling activities. The methodology is generic in nature and may be modified in whole or part to meet the handling and analytical requirements of the contaminants of concern, as well as the constraints presented by site conditions and equipment limitations. Modifications of sampling methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and analytical results. For the purposes of this procedure, soils are those mineral and organic materials not submerged in water for an extended period of time sufficient to support aquatic life.

Equipment/Apparatus

Equipment needed for PID screening of soil samples may include:

- PID/FID instrument
- Clear glass jar
- Ziploc bags

Procedure

When using PID/FID instrument the following procedure must be used:

1. Half- fill **either** a glass jar, or a Ziploc® baggie.
   a) When using glass jars:
      i) Fill jars with a total capacity of 8 oz. or 16 oz.
      ii) Seal each jar with one (1) or two (2) sheets of aluminum foil with the screw cap applied to secure the aluminum foil.
   b) When using Ziploc® baggies:
      i) Half fill bags from the split spoon or the excavation.
      ii) Zip to close.
2. Vigorously shake the sample jars or bags for at least thirty (30) seconds once or twice in a 10-15 minute period to allow for headspace development.
3. If ambient temperatures are below 320 Fahrenheit (00 Celsius) headspace development is to be within a heated vehicle or building.
4. Quickly insert the PID/FID sampling probe through the aluminum foil. If plastic bags are used, unzip the corner of the bag approximately one to two inches and insert the probe or insert the probe through the plastic. Record the maximum meter response (should be within the first 2 to 5 seconds). Erratic responses should be discounted as a result of high organic vapor concentrations or conditions of elevated headspace moisture.
5. Record headspace screening data from both jars or bags for comparison.

6. A PID equipped with a 10.2 eV lamp source will be used. Calibration will be checked/adjusted daily. In addition, all manufacturers' requirements for instrument calibration will be followed.
7. If sample jars are re-used in the field, jars will be cleaned according to field decontamination procedures. In addition, headspace readings must be taken to ensure no residual organic vapors exist in the cleaned sample jars.
8. Plastic bags will not be re-used.

Standard Operating Procedure F-10
Staff Gage Installation and Measurement

This standard operating procedure (SOP) is applicable to the installation and measurement of staff gages. This SOP is generic in nature and may be modified in whole or part depending on constraints presented by site conditions and equipment limitations. Modifications of methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities. The procedures have been adapted from the Oklahoma Water Resources Program Division procedures for installation and monitoring of non-recording staff gages.

Installation of Staff Gages

The gage height is a critical component for establishing the stage to discharge relationship and can be measured through a variety of accepted means. It is used to establish the river gage, or height of water to a known fixed point. This known fixed point is referenced or leveled to a Reference mark or Benchmark. These marks are assigned either an arbitrary elevation or known elevation that is tied to a national elevation network. Thus over time, with periodic leveling, the reference points can be measured for movement. Movement of these points will affect the stage discharge rating; therefore, it is critical that periodic measurements be conducted so that the gage heights remain leveled with the stage datum. This document is meant to be a guide only. Since staff gage equipment varies with respect to installation requirements, this SOP will be provided for a guideline and the specific manufacturer's instruction manual will be relied upon for more detailed guidance on the use of specific staff gages.

Accuracy and Use of Staff Gages

Vertical Staff Gages

Vertical staff gages are used as a stand-alone outside gage, an outside gage at a recording station, or a reference gage to another non-recording device. Vertical gages are available in a variety of lengths, widths, and increments in both U.S. and metric scales. However, because of the necessary accuracy, comparability, and ruggedness, gages should be a Style A gage, if available, which is made of porcelain enameled iron sections measuring 3 1/3' by 4" and graduated at every foot, tenth, and 0.02 foot. They are accurate only to 0.02 foot and can be damaged or lost due to high flows or ice. They have a tendency to drift if not consistently kept free of debris. Accuracies to 0.01 foot may be obtained if needed by reading the gage with a point gage.

Inclined Staff Gages

Because of their uniqueness to each station, inclined gages are normally not available commercially for stream gaging. They are used in situations where placement of another type of outside gage is not possible. They can be used as stand-alone outside gages or as an outside gage at a recording station.

Inclined gages have a low level of accuracy of up to 0.10 foot. Because of issues with installation, maintenance, and accuracy, inclined staff gages should be used only when other options are not feasible.

Installation and Measurement of Staff Gages

A vertical gage is mounted to permanently placed structure such as a piers or beam sunk to bedrock. If mounted in a stable location, a number of plates may be mounted one on top of the other. When mounting, find the high water bench and attempt to place the top of gage above that mark. Vertical height of gages should be kept to one plate and may require the installation of two or more to account for the vertical height of banks and potential high water level. When mounting to a pier, special equipment may be needed. The gage should be kept free of obstructions and be in an area readily accessible by personnel. A reference point should be placed on the backing of the gage plates and tied into the level circuit, and a reference point reading should be noted by measuring against the steel plate using a steel tape. During subsequent surveys, new RP readings should be made and compared to the elevation for that reference point. If these are different, a correction should be made to the gage datum. If a series of gages are used, each should be tied to the level circuit with a separate reference point.

The water level is read by a three-step method. The following example describes the three step process:

1. As an example, 20.64 is used as a measurement.
2. The footmark, 20.0, is noted. The next mark (6) is the inch mark.
3. The next step is to locate the hundredth mark and count 8 the marks backward from the next highest inch mark.

Using the example, the water level is at 0.64, and to determine the hundredth mark (0.04), the technician would count back from 0.7 to the water level. In this instance, the count was 0.06. By subtracting 0.06 from the inch mark, the hundredth mark (0.04) is obtained.

References

Oklahoma Water Resources Board, 2004. Standard Operating Procedure for the Installation of Nonrecording Gages and Measurement of Stage in Streams. Water Quality Program Division, Oklahoma City, OK.

Oklahoma Water Resources Board, 2004. Standard Operating Procedure for Surveying Gaging Stations. Water Quality Program Division, Oklahoma City, OK.

Standard Operating Procedure F-11
Groundwater Sampling and Field Measurement Procedures

This standard operating procedure (SOP) sets forth the field procedures for the sampling of groundwater. The procedures include monitoring well inspection, groundwater elevation measurement, decontamination of nondedicated sampling equipment, and groundwater sampling. A separate SOP, F-15 is included for well construction activities.

Monitoring Well Inspection

The condition of the monitoring wells will be inspected and documented during each sampling event prior to the collection of data. The following information will be noted on a monitoring well inspection form (Attachment B):

- The ground surface condition around the well (vegetation, safety hazards, access hazards, etc.)
- Well security features (presence of lock, lock key number, protective bollards, paint, visibility devices, evidence of tampering, traffic hazards, etc.)
- Condition of the well surface completion, including surface protector, protector cover, inner casing cap or plug, and concrete pad
- Evidence of potential contamination at the wellhead, including staining or suspicious containers

Groundwater Elevation Measurement

In order to determine the static water elevation (SWE), the static water level (SWL) will be measured prior to purging and sampling at each monitoring well in the sampling program. All static water level measurements will be obtained on the first day of the sampling event or within a 24-hour period, except as described in the following section. The measurements will be obtained prior to purging the monitoring wells for water quality sampling. Each well has a top-of-casing (TOC) reference point marked on it, from which all water level measurements will be taken. The vertical reference points have been surveyed to the nearest 0.01 foot and referenced to North American Vertical Datum (NAVD) 88.

Decontamination Procedures for Nondedicated Sampling Equipment

Proper decontamination of sampling equipment is essential to minimize the possibility of cross-contamination of samples. Nondedicated equipment used for sampling various environmental media (soil, groundwater, surface water, etc.) will be cleaned before its initial use in the field and again before use at each subsequent sampling site.

All nondedicated sampling equipment will be new, or will be decontaminated at RMT prior to its initial use on-site. Decontamination procedures will include the following steps:

1. Wash the equipment in a nonphosphate detergent.
2. Rinse with potable tap water.

3. Rinse with deionized (DI) or distilled water.

Nondedicated equipment that is to be used at additional locations at the site will be field-decontaminated between sampling locations. Details regarding the decontamination of field equipment are included in the sampling procedures described below. The field decontamination procedures will be in accordance with the Michigan Department of Environmental Quality (MDEQ) Remediation and Redevelopment Division Operation Memorandum Number 2, Appendix 7 (MDEQ, 2004).

The field decontamination of sampling equipment will take place at the sampling location. All decontamination water will be contained in 5-gallon buckets and transported to the decontamination pad for collection with other decontamination wastewater.

The field equipment blanks will be collected in accordance with the sampling methodology specified in Appendix 7 (MDEQ, 2004).

To the extent practicable, single-use sampling equipment and materials will be used for the collection of all environmental samples. The materials used will be new and clean, and will be placed in plastic for transport to the site. Once used, this equipment will be placed in plastic bags and managed as investigation-derived waste material.

Groundwater Sampling Procedures

The wells will be developed to ensure that the wells have a good hydraulic connection with the shallow aquifer. The wells will be developed by surging and purging with a surge block and submersible pump system. Well development will be performed until the water discharged from the wells is free of sediment, if possible. Well development procedures involving the introduction of water will be performed in consultation with the U.S. EPA and are further described in SOP-15, included in this FSAP.

Groundwater samples from monitoring wells will be collected using a low-flow sampling methodology specifically designed for the project specific analytical sampling as described in the workplan. Low-level sampling and analytical methods will be used for mercury, as appropriate. The sampling will be consistent with Attachment 7 (MDEQ, 2004).

Low-level mercury sample collection is performed by a strict protocol designed to minimize contamination. The protocol involves a two-person team approach. One member of the team is designated as “Dirty Hands,” and the second member is designated as “Clean Hands.” “Clean Hands” handles all operations involving contact with the sample bottle and transfer of the samples from the tubing or pump outlet to the sample bottle. “Dirty Hands” prepares the sampling equipment, operates the sampling equipment, and is responsible for any other activities that do not involve direct contact with the sample. Non-talc gloves and lint-free outer clothing are required to protect the samples from contamination by lint and dust. Sampling equipment, materials, and containers are cleaned and doublebagged for protection from contamination during storage and transportation. The field equipment is decontaminated with deionized water. The samples are preserved with high-purity, diluted hydrochloric acid (HCL).

Each monitoring well will be pumped using a peristaltic pump and fluoropolymer tubing. At wells where the depth to water is greater than 20 feet, a QED bladder pump (or equivalent) will be used instead of the peristaltic pump. The bottom of the tubing (or bladder pump intake) will be placed approximately 1 to 2 feet above the base of the well screen, and the well will be pumped at a flow rate ranging from 0.1 to 0.7 liter/min. The pumping rate for each monitoring well is dependent on the hydraulic properties of the formation the well is screened across, and will be determined in the field to be the highest flow rate attainable without creating drawdown greater than approximately 0.1 meter, or at a minimum of 100 mL/min. In the event that the aquifer transmissivity is too low to yield sufficient water to limit drawdown to 0.1 meter at the lowest specified pumping rate (0.1 liter/min), sampling will be conducted at the 0.1 liter/min rate since this is the minimum flow rate necessary for accurate measurements through the flow-through cell.

A Geotech P3 flow-through cell (or equivalent) equipped with temperature, turbidity, dissolved oxygen, specific electrical conductance, and pH electrodes will be connected to the discharge tubing from the peristaltic pump. Equipment operation manuals for this meter is included in this SOP. In addition, a hard copy of the instruction manual specific for the field instrument will be available in the field during implementation activities. If this specific model is unavailable at the time of sampling, a comparable model will be substituted and the appropriate version of the instruction manual will be provided to the USEPA in the next monthly progress report. Each of these parameters will be measured at each well during purging to evaluate stabilization. Wells will be considered stable when the following conditions apply between three successive 1-liter sampling intervals:

- The temperature change is within 0.5°C.
- The conductance change is within 20 µhmos/cm.
- The turbidity change is ± 10 percent or <10 NTUs.
- The dissolved oxygen change is within 0.5 mg/L.
- The redox (Eh) change is within 30 mv.
- The pH change is within 0.2 pH units.

The wells will be sampled immediately following stabilization. The samples will be taken from the pump discharge after the flow-through cell has been disconnected. The low-level mercury sample will be collected first following the Clean Hands/Dirty Hands method described in Attachment 7 (MDEQ, 2004). The remaining sample bottles will then be collected from the pump discharge.

Regardless of the sampling technique used, efforts will be made to minimize agitation/disturbance of samples during purging and sampling activities. Likewise, efforts will be made to avoid purging wells dry if at all possible.

Groundwater purged during sampling, used pump tubing, and other general waste materials generated by the sampling process will be collected and managed as investigation-derived waste.

Calibration Procedures - The pH, ORP, specific conductance, turbidity, and dissolved oxygen meters will be calibrated daily in accordance with manufacturer's instructions. As noted previously, manufacturer's instructions will be included in the SOP and hard copies will be available to field personnel. Calibration information will be recorded in the field logbook.

Operation Procedures - The sampling pump, flow-through cell, and meters will be operated according to the manufacturer's instructions. As noted previously, manufacturer's instructions will be included in the SOP and hard copies will be available to field personnel.

Maintenance Procedures - The sampling pump, flow-through cell, and meters will be maintained according to the manufacturer's instructions. Maintenance information will be recorded in the field logbook. Replacement sampling pumps, flow-through cells, and meters will be available on-site or ready for overnight shipment, as necessary. As noted previously, manufacturer's instructions will be included in the SOP and hard copies will be available to field personnel.

Sample Handling and Chain of Custody

Field personnel will be aware of the holding times for specific parameters and will make arrangements to have the samples delivered to the laboratory to meet these holding times. No samples will be held overnight for field activities lasting longer than 1 day. All samples will be stored on ice after collection and shipped to the laboratory on the same day on which they are collected.

This Chain-of-Custody documentation enables possession of a sample to be traced from sample collection through analysis and disposal. A Chain-of-Custody protocol will be established to document control of the samples from the point of collection to delivery to the analytical laboratory. Samples will be under the custody of a designated person at all times. The control of custody will be documented on a Chain-of-Custody form supplied by the laboratory. The Chain-of-Custody form will document the names, signatures, and affiliations of personnel in custody of the samples, and the dates and times custody was transferred. The sampling personnel will be responsible for sample custody in the field. The laboratory sample custodian and analysts will be responsible for custody of the sample at the laboratory.

A copy of the Chain-of-Custody form will be placed in the project files, and the original will accompany the samples to the laboratory. The identity of field duplicate samples will not be disclosed to the analytical laboratory. Sample analysis request forms will be prepared by sampling personnel and reviewed by the project coordinator or project manager. The analytical request forms will either accompany the samples to the laboratory or will precede the delivery of samples to the laboratory.

Shipping containers will be sealed and will be accompanied by the Chain-of-Custody form, with appropriate signatures. The transfer of custody is the responsibility of the sampling personnel and the laboratory staff. The procedures to be implemented are as follows:

- Place completed chain-of-custody forms in a plastic bag, seal the bag, and tape it to the inside cover of the shipping container.
- After the samples are iced, seal the coolers with strapping tape and custody seals (if applicable), add the date to the custody seals, and ship the coolers to the laboratory using overnight delivery or by delivering them directly to the laboratory.
- Identify common carriers or intermediate individuals on the Chain-of-Custody form, and retain copies of all bills-of-lading.
- When the samples are received in the laboratory, handle and process them in accordance with the procedures in the laboratory's standard operating procedures (SOPs), or specified analytical methods.

In the laboratory, a sample custodian will be assigned to receive the samples. Upon receipt of the samples, the custodian will inspect the condition of the samples, reconcile the samples received against the Chain-of-Custody form, check the temperature of the samples, log the samples in the laboratory log book, and store the samples in a secured sample storage room or cabinet maintained at an appropriate temperature until assigned to an analyst for analysis. Custody will be maintained until the samples are discarded.

When samples requiring preservation by either acid (except samples for VOC analysis) or base are received at the laboratory, the pH will be measured and documented. The laboratory sample custodian will adjust the pH, if necessary, and will notify the laboratory Quality Assurance/Quality Control (QA/QC) Coordinator of the pH adjustment so that sample collection procedures can be reviewed to determine if a modification is necessary.

Discrepancies observed between the samples received, the information on the Chain-of-Custody form, and the sample analysis request sheet will be resolved before the sample is assigned for analysis. The laboratory QA/QC Coordinator will be informed of any such discrepancy, as well as its resolution. Results of the inspection will be documented in the laboratory sample logbook. Discrepancies will be documented in the analytical case narrative, as appropriate.

References

MDEQ. 2004. Remediation and Redevelopment Division operation memorandum Number 2, Appendix 7.

2020
TURBIDIMETER

Instruction MANUAL

TABLE OF CONTENTS

GENERAL INFORMATION

PACKAGING & DELIVERY

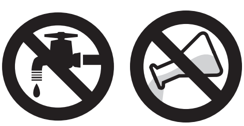
Experienced packaging personnel at LaMotte Company assure adequate protection against normal hazards encountered in transportation of shipments. After the product leaves the manufacturer, all responsibility for safe delivery is assured by the transportation company. Damage claims must be filed immediately with the transportation company to receive compensation for damaged goods.

Should it be necessary to return the instrument for repair or servicing, pack the instrument carefully in a suitable container with adequate packing material. A return authorization number must be obtained from LaMotte Company by calling 1-800-344-3100 or faxing 1-410-778-6394. Attach a letter with the authorization number to the shipping carton which describes the reason for the return. This information will enable the service department to make the required repairs more efficiently.

GENERAL PRECAUTIONS

Read the instruction manual before attempting to set up or operate this instrument. Failure to do so could result in personal injury or damage to the instrument.

The 2020 Turbidimeter should not be stored or used in a wet or corrosive environment. Care should be taken to prevent water from wet turbidity tubes from entering the turbidimeter light chamber.



NEVER PUT WET TUBES IN THE TURBIDIMETER.

SAFETY PRECAUTIONS

Read the label on all reagent containers. Some labels include precautionary notices and first aid information. Certain reagents are considered hazardous substances and are designated with a * in the instruction manual. Material Safety Data Sheets (MSDS) are supplied for these reagents. Read accompanying MSDS before using these reagents. Additional emergency information for all LaMotte reagents is available 24 hours a day from the Poison Control Center listed in the front of the phone book. Be prepared to supply the name and four digit LaMotte code number found on the container label or at the top of the MSDS. LaMotte reagents are registered with a computerized poison control information system available to all local poison control centers.

LIMITS OF LIABILITY

Under no circumstances shall LaMotte Company be liable for loss of life, property, profits, or other damages incurred through the use or misuse of their products.

SPECIFICATIONS

Instrument Type	Nephelometric turbidity, calibrated in NTU
Range	0.00 -1100 NTU
Accuracy	.05 or ±2% for readings below 100 NTU, whichever is greater ±3% above 100 NTU
Resolution	*Standard Mode* 0.01 from 0.00 -10.99 NTU 0.1 from 11.0 -109.9 NTU 1 from 110 -1100 NTU *EPA Mode* NTU — Reported to the nearest NTU 0 - 1.0 — 0.05 1.0 - 10 — 0.1 10 - 40 — 1 40 - 100 — 5 100 - 400 — 10 400 - 1000 — 50 1000 — 100
Display	3½ digits
Response Time	5 seconds
Warm-up time	Not required
Automatic Shut Off	2 minutes
Lamp	Tungsten Filament bulb (approximate life 800 hours)
Sample	15 mL in capped tube
Sample Chamber	Accepts 25mm diameter flat-bottomed tubes (capped)
Power source	Battery Operation: 9 Volt Alkaline Line Operation: 120V/50Hz, 220V/60Hz*, with supplied adapter
Size (L X W X H)	8.5 x 16.2 x 6.7 cm, 3.4 X 6.4 X 2.6 inches
Shipping Weight	Meter only: 11 oz. (312g) Kit: 3 lb. 7 oz. (1560g)
Serial Interface	RS232, 8 pin mDIN, 9600b, 8, 1, n

**CE Mark: The devise complies to the product specifications for the Low Voltage Directive when furnished with the 220V AC Adapter (Code 1774). The 120V AC adapter is not CE approved.*

PARTS & ACCESSORIES

Included in the Model 2020 Turbidity Meter Kit (Code 1799 OR 1799-EX2):

Code	*Item*
26856	2020 Turbidity Meter
1726-110	AC Adapter, 9V (or 1726-220 with 1799-EX2)
1476	AMCO™ 2020 Turbidity Standard, 1.0 NTU, 60 mL
1477	AMCO™ 2020 Turbidity Standard, 10 NTU, 60 mL
0286-4	Turbidity tubes, set of 4

Optional Accessories:

1478	AMCO™ 2020 Turbidity Standard, 100 NTU, 60 mL
1479	AMCO™ 2020 Turbidity Standard, 250 NTU, 60 mL
1800	High Turbidity Dilution Kit includes: Syringe, Filter Holder, Membrane Filters
0943	Syringe
0598	Filter holder
1103-6	Membrane Filters, 0.45 micron, pkg of 6
5115PS-H	Deionized Water, 60 mL
6195-H	Formazin Turbidity Standard, 4000 NTU, 60 mL

EPA COMPLIANCE

This instrument meets or exceeds EPA design specifications for NPDWR and NPDES turbidity monitoring programs as specified by the USEPA method 180.1. There is also a compliance reading mode which rounds the reading to meet EPA reporting requirements.

WARRANTY

This instrument is guaranteed to be free from defects in material and workmanship for one year from original purchase date. If within that time the instrument is found to be defective, it will be repaired without charge except for transportation costs. The guarantee does not cover batteries.

CE COMPLIANCE

The 2020 Turbidimeter has been independently tested and has earned the European CE Mark of compliance for electromagnetic compatibility and safety.

DECLARATION OF CONFORMITY

Application of Council Directives:	89/336/EEC
Standards to which Conformity Declared:	EN55022, EN50082-1, En600950
Manufacturer's Name:	LaMotte Company
Manufacturer's Address:	802 Washington Avenue PO Box 329 Chestertown, MD 21620
Importer's Name:	Reagecon Diagnostics Ltd
Importer's Address:	13 A/D Shannon Free Zone Shannon, Co. Clase. Ireland
Type of Equipment:	Water Quality Meters
Model Number:	2020/1200
Year of Manufacture:	1997

I, the undersigned, hereby declare that the equipment specified above conforms to the above Directive and Standards.

Chestertown, Maryland
Place

James K. Trumbauer
Signature

3-19-97
Date

James K. Trumbauer
Name

V.P., Director of Research & Development
Position

NOTE: The device complies to the product specifications for the Low Voltage Directive when furnished with the 220V AC Adapter (Code 1774).

WHAT IS TURBIDITY?

Turbidity, cloudiness in water, can be interpreted as an absence of clarity or brilliance. It is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter and microscopic organisms. Turbidity should not be confused with color since a darkly colored water can still be clear and not turbid.

Turbid water is often an indicator of conditions that could cause damage to manufacturing equipment. Water clarity is especially important to the producers of consumer products such as beverage producers, food processors and water treatment plants. The particulates that cause turbidity may not always be harmful to human health, but are considered an undesirable characteristic.

Turbidity in industrial water used for boiler and cooling systems should be as low as possible. In boilers, the particles may become concentrated and settle out as a sludge that will damage equipment and cause foaming. In cooling water systems, particles can interfere with corrosion inhibitors. Water clarity is improved with fluid-particle separation processes such as sedimentation, coagulation and filtration.

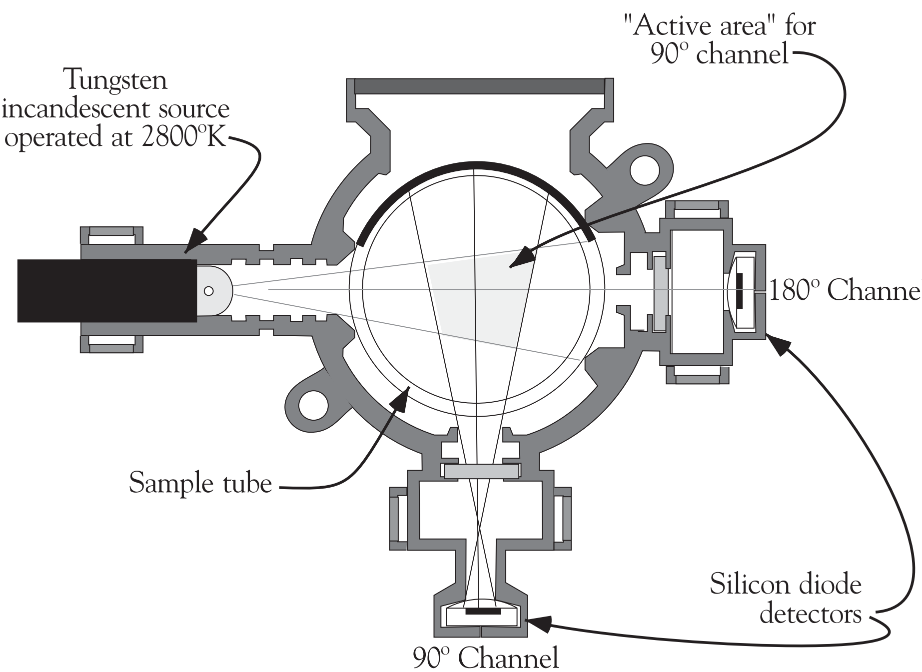
In swimming pools, cloudy water is a common problem. The usual causes for poor water clarity are corrosion, improper filtration and/or improperly balanced water. An algae condition or severe chloramine condition can also cloud pool water.

In natural waters, turbidity is an indicator of quality and productivity and can be used to monitor the health of streams and lakes. Turbid water may indicate runoff from construction, agriculture or other types of pollution. Suspended sediment can carry nutrients and pesticides throughout the water system. Suspended particles near the surface absorb additional heat from sunlight, raising the water temperature and blocking out the light needed by submerged aquatic vegetation and bottom dwelling creatures.

HOW IS TURBIDITY MEASURED?

Light passing through clear water will travel in a straight line. Particles in turbid water will cause the light to scatter giving it a "cloudy" appearance. The turbidity of a sample is determined by measuring the amount of scatter when a light is passed through a sample. The higher the turbidity, the greater the amount of scatter.

Turbidity can be measured in many ways. Visual methods include, the comparative methods, the Secchi disk method and the Jackson Candle method. Comparative methods are used in shallow water and determine turbidity by matching the turbidity of a water sample to a standard of known turbidity either with a "target" at the bottom of a tube or with a turbidity comparator. In the deeper waters of lakes, ponds, rivers and estuaries the Secchi disk is often used to measure turbidity. The Secchi disk is a disk about eight inches in diameter that is either white or is marked with black and white quadrants. The disk is lowered into the water on a calibrated line and the depth is noted where the disk just disappears from sight. The disk is then raised until it is visible. The average of these two distances is known as the "Secchi depth".



2020 Nephelometer

At waterworks and wastewater treatment plants the Jackson Candle apparatus was a standard instrument for measuring turbidities of incoming raw waters and treated wastewater effluents for many years. The equipment was modified over time but originally it consisted of a long glass tube supported over a "standard candle." Water was added to or removed from the tube until the image of the candle flame became indistinct. The depth of the water in the tube was read off a calibrated scale etched into the side of the tube, and results were reported numerically as Jackson Turbidity Units (JTU). The lowest turbidity that can be determined with this method is 25 Nephelometric Turbidity Units (NTU). Since the EPA's Surface Water Treatment requirements state that, finish water from municipal treatment plants will have a turbidity less than 1 NTU, indirect methods were developed to measure turbidity. Turbidimeters are the preferred method.

Nephelometers, such as the 2020, are turbidimeters that measure the scattered light at 90 degrees from the light source. A reference beam passes through the sample and is measured at 180 degrees. The ratio of these two readings is electronically converted to a turbidity measurement in NTU.

GENERAL OPERATING INFORMATION

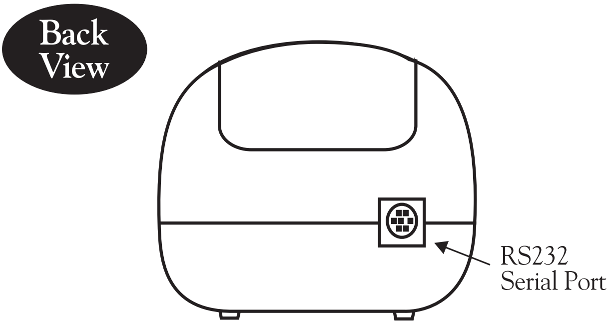
OVERVIEW

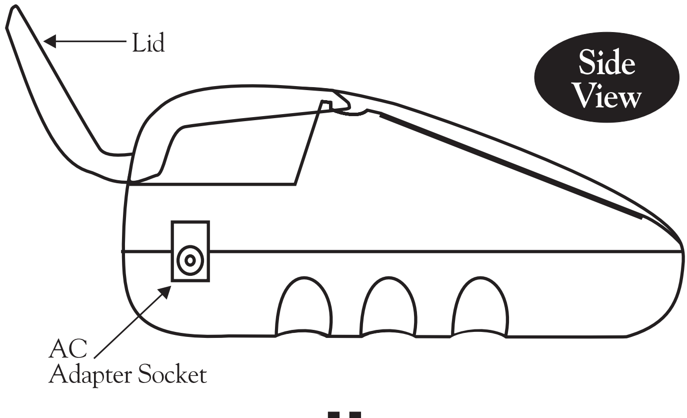
The 2020 Turbidimeter is a portable, microprocessor controlled nephelometer. A multi-detector optical configuration assures long term stability and minimizes stray light and color interferences. All readings are determined by the process of signal averaging over a 5 second period, minimizing fluctuations in readings attributed to large particles and enabling rapid, repeatable measurements. It has a sealed keypad. The microprocessor enables auto-ranging over the full range of 0 to 1100 NTU and provides direct digital readout with a resolution of 0.01 NTU for the lowest range.

The optics feature a tungsten bulb light source with a life expectancy of 800 hours. The light is detected by a silicon photo diode.

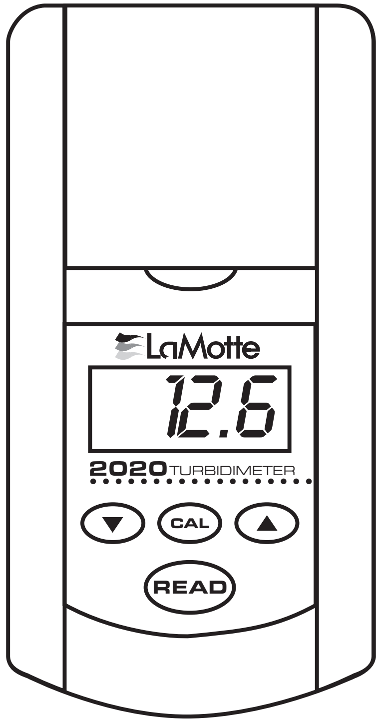
The 2020 is supplied with a 9 volt alkaline battery and an AC power adapter. A fresh battery should be installed at all times, even when using the power adapter. This will ensure that the meter will power down properly.

A RS-232 serial port on the back of the meter allows an interface of the turbidimeter with an IBM compatible computer for real time data acquisition and data storage using the PC. This port also allows an interface with a RS-232 serial printer.

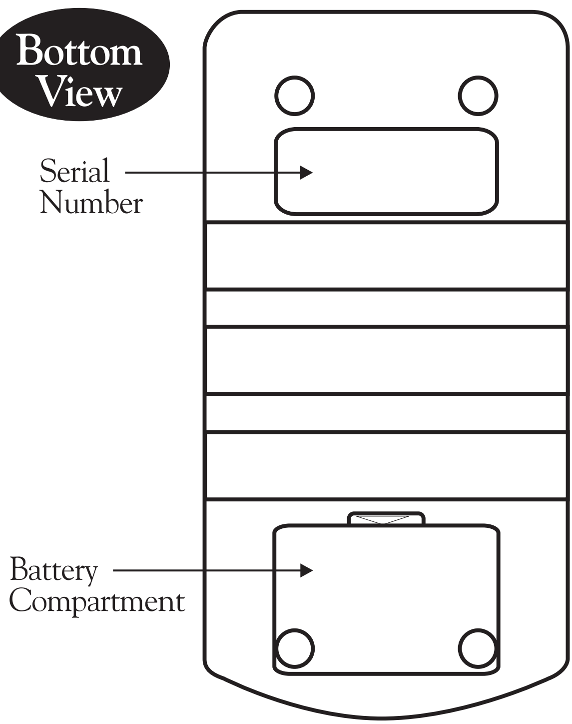




Top View



Bottom View



THE KEYPAD

The DISPLAY will display turbidity reading with the following resolution:
0.00 - 10.99 NTU; 11.0 - 109.9 NTU; 110 - 1100 NTU

- When the **READ** button is first pushed, a number will be briefly displayed that indicates the software version number.
- A walking dash "–" will be displayed when measurement is taking place.
- The display will flash after the **CAL** button has been pushed during the calibration procedure until the **CAL** button has been pushed again to enter the adjusted value.
- "OFF" will be displayed after the **READ** button has been held down for 1 second. The meter will turn off when the button is released.
- "ER1" will be displayed when the battery voltage is very low.
- "ER2" will be displayed when measured turbidity is over range (1100 NTU).
- "ER3" will be displayed when the bulb has burned out or the tube is misaligned.
- "BAT" will be displayed when the battery voltage is getting low. Readings are reliable. The meter should not be operated if the battery low indicator has appeared. Replace battery as soon as possible.
- "▲" will be displayed when the meter is in EPA mode.

See
TROUBLE
SHOOTING
GUIDE
page 23

The DOWN ARROW will DECREASE the numerical value of the display while in calibration mode.

The UP ARROW will INCREASE the numerical value of the display while in calibration mode.

The READ button is used to turn the meter ON and to take readings. Pressing the button for 1 second will cause the meter to display OFF. Releasing the button when OFF is displayed turns the meter OFF.

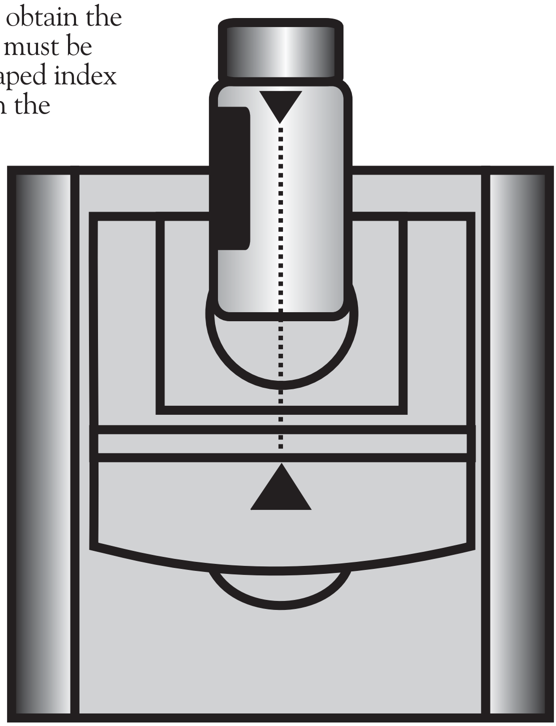
The CAL button is used for CALIBRATION procedures and to change between standard operating mode and EPA mode.

TURBIDITY TUBES

Turbidity tubes should always be washed prior to use. Use a mild detergent to remove any dirt or finger prints. Dry the outside of the turbidity tubes with a clean, lint-free cloth or disposable wipe. Allow the turbidity tubes to air-dry in an inverted position to prevent dust from entering the tube.

The handling of the turbidity tubes is of utmost importance. Scratches, fingerprints and water droplets on the turbidity tube or inside the light chamber can cause stray light interference leading to inaccurate results. It is imperative that the turbidity tubes and light chamber be clean and dry. Scratches and abrasions will permanently affect the accuracy of the readings. The inside of the tubes can be acid washed periodically and coated with special silicon oil to mask imperfections in the glass. Avoid acid contact with the black ink on the outside of the tubes. After a tube has been filled and capped, it should be held by the cap and the outside surface should be wiped with a clean, lint-free absorbent cloth until it is dry and smudge-free. Handling the tube only by the cap will avoid problems from fingerprints. Always set the clean tube aside on a clean surface that will not contaminate the tube.

Variability in the geometry and quality of the glassware is the predominate cause of variability in results. The special anti-reflective area on the 2020 tubes allows more accurate turbidity readings for low NTU samples. Only 2020 tubes should be used with the 2020 turbidimeter. Orientation of the tube in the chamber will greatly affect the test results. To obtain the most accurate results, the tubes must be positioned so that the arrow-shaped index mark on the tube is aligned with the arrow-shaped index mark molded into the housing in front of the light chamber. This will ensure that the most accurate results are obtained.

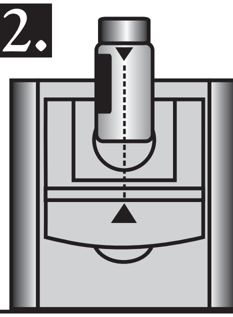


The turbidity tubes are optically selected but very small variations in the tubes may cause different readings on the same sample in low turbidity water. If greater accuracy is required, such as for drinking water requirements, the tubes supplied with the 2020 should be individually calibrated. This procedure is important for reading below 10 NTU but is not needed for samples above 10 NTU.

1.

Fill each tube (0286) with high-quality water. (Generally distilled water or drinking water is sufficient.)

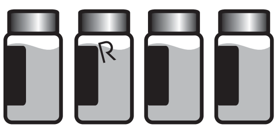
2.



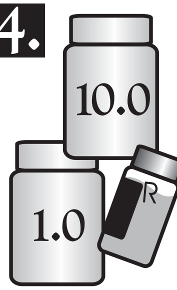
Record a turbidity reading for each tube following the instructions for turbidity measurement on page 19.

3.

Mark the tube with the lowest reading with an "R", for reference turbidity tube, near the top of the tube with a permanent marker.



4.

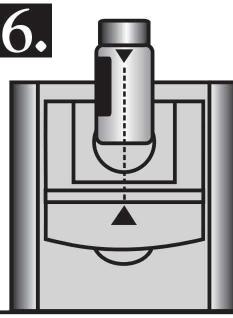


Follow the Calibration Procedure on page 17 using the reference turbidity tube, turbidity-free water, and the 1.00 NTU or 10.0 NTU AMCO™ standard.

5.

Fill the remaining turbidity tubes with the same AMCO™ turbidity standard as in the reference turbidity tube.

6.



Insert each tube into the meter with the proper orientation, Close lid and record the reading for each tube.

7.

The difference between the theoretical value (1.00 NTU or 10.0 NTU) and the actual value is the correction factor for that tube. This factor should be used when comparing results from different tubes.

CALIBRATION

STANDARD SOLUTIONS

The 2020 has been pre-calibrated in the range of 0 to 1100 NTU with AMCO™ primary standards manufactured by Advanced Polymer Systems, Inc. This allows the 2020 to be used for treated water, natural water or wastewater. Recalibration of the 2020 by the user is not required. However, a procedure to standardize the calibration should be performed to obtain the most accurate readings over a narrow range.

Two AMCO™ standards of 1.00 NTU and 10.0 NTU are supplied with the 2020. Standards of other values are available as accessories. The standards are a suspension of uniformly sized plastic “micro spheres” in ultra pure water, which require no preparation and are stable for long periods of time. These standards were manufactured specifically as a reference to calibrate the 2020. Only LaMotte specific AMCO™ standards should be used with the 2020. These standards are guaranteed to be accurate to within ±1%, if the following precautions are observed:

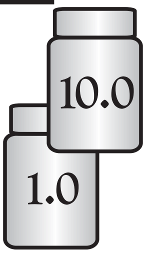
- The standards will remain stable for up to one year after the fill date.
- Never pour any unused or used standard back into the primary standard bottle.
- Do not open the bottle in a dusty or dirty environment. Dust and contaminants from the air can ruin the quality of the standard solutions.
- Before filling a tube with a standard, rinse the inside of the tube with a small amount of standard.
- Cap the standard bottle and the tube immediately after filling.

With proper preparation techniques, freshly prepared Formazin standards should be equivalent to the AMCO™ standards and can be used for meter calibration. A 4000 NTU Formazin Standard is available from LaMotte Company for use in preparing calibration standards. (See “Optional Accessories,” pg. 6.) Correct procedures and approved methods for the use of Formazin standards can be found in the current edition of Standard Methods for Examination of Water and Wastewater.

Note: Change battery when ERI (very low battery) is displayed. Operating the meter with a very low battery could result in permanantly erasing the calibration.

CALIBRATION PROCEDURE

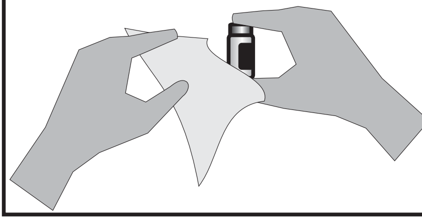
1.



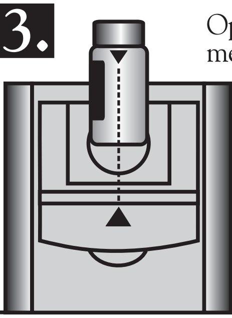
Select a LaMotte AMCO™ 2020 Standard in the range of the samples to be tested. NOTE: Only use LaMotte AMCO™ Standards specific to the 2020 Turbidimeterr. Contact LaMotte for replacement standards.

2.

Fill a turbidity tube with the standard, cap, and wipe the tube clean with a lint-free cloth.



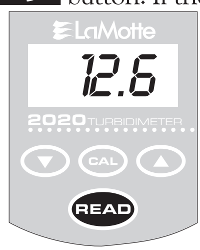
3.



Open the lid of the meter. Align the indexing arrow mark on the tube with the indexing arrow mark on the meter, and insert the tube into the chamber.

4.

Close the lid. Push the **READ** button. If the displayed value is not the same as the value of the reacted standard (within the specification limits), continue with the calibration procedure.



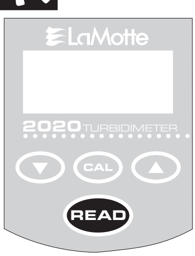
5.

Push the **CAL** button for 5 seconds until **CAL** is displayed. Release button. The display will flash. Adjust the display with the ▼ and ▲ buttons until the value of the standard is displayed.

6.

Push the **CAL** button again to memorize the calibration. The 2020 display will stop flashing. Calibration is complete.

7.



Turn the unit off by holding the **READ** button down for at least 1 second, or proceed to measure the test samples following the procedure on page 19.

Note

The calibration procedure should be followed once a week, or more often as required by regulations and laws for compliance monitoring. The calibration of the meter is independent of the operating mode.

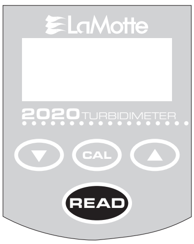
ANALYSIS PROCEDURES

SELECTING THE EPA MODE

The 2020 turbidity meter has two operating modes, the standard operating mode and the EPA mode. The meter can only be switched from one mode to the other while turning the 2020 on, from the OFF state. The 2020 will remain in which ever mode it was last used, even if the meter has been turned OFF.

To switch from one mode to the other mode:

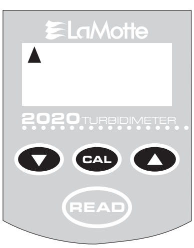
1.



Turn OFF the 2020, if it is on.

2.

Press **CAL** button and hold it down while pressing the **READ** button to turn the meter on.



The meter will come on in the opposite mode than it was in previously. (While in EPA mode the ▲ will be visible on the display).

The standard operating mode displays the measured turbidity to the full resolution of the meter. The EPA mode displays the measured turbidity rounded to the reporting requirements of the EPA and Standard Methods compliance monitoring programs. This greatly simplifies the reporting requirements by eliminating the need for the user to manually round off the results according to EPA specifications. The EPA requires these reporting requirements because it recognizes the inherent accuracy of turbidity measurements within the specified ranges.

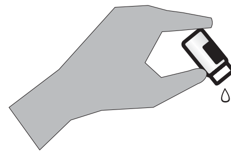
Note: The calibration of the meter is independent of the operating mode.

1.

Fill a clean container with at least 50 mL of sample water and cover. Set sample aside to allow sample to equilibrate to air temperature and let gases escape. Avoid contaminants. Analyze as soon as possible.

2.

Rinse an empty turbidity tube with a portion of the sample. Shake out excess water.

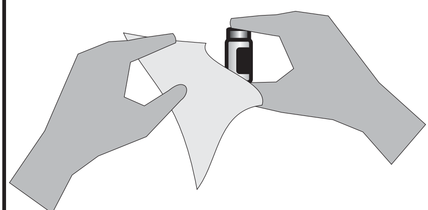


3.

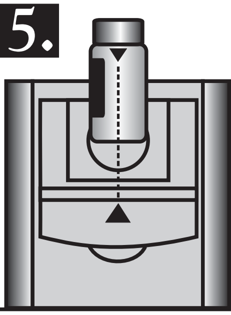
Fill the turbidity tube (0286) to the neck by carefully pouring the sample down the side of the tube to avoid creating bubbles.

4.

Cap the tube and wipe tube dry with a clean lint-free tissue.



5.

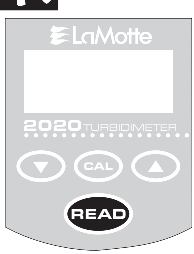


Open the 2020 lid. Align the indexing arrow on the tube with the indexing arrow on the meter. Insert the turbidity tube into chamber.

6.

Close the lid. Push the **READ** button. The turbidity in NTU units will be displayed within 5 seconds.

7.



The 2020 will turn off automatically 2 minutes after the last button push. To turn the meter OFF manually, hold the **READ** button down for at least 1 second. Release the button when OFF is displayed.

Note

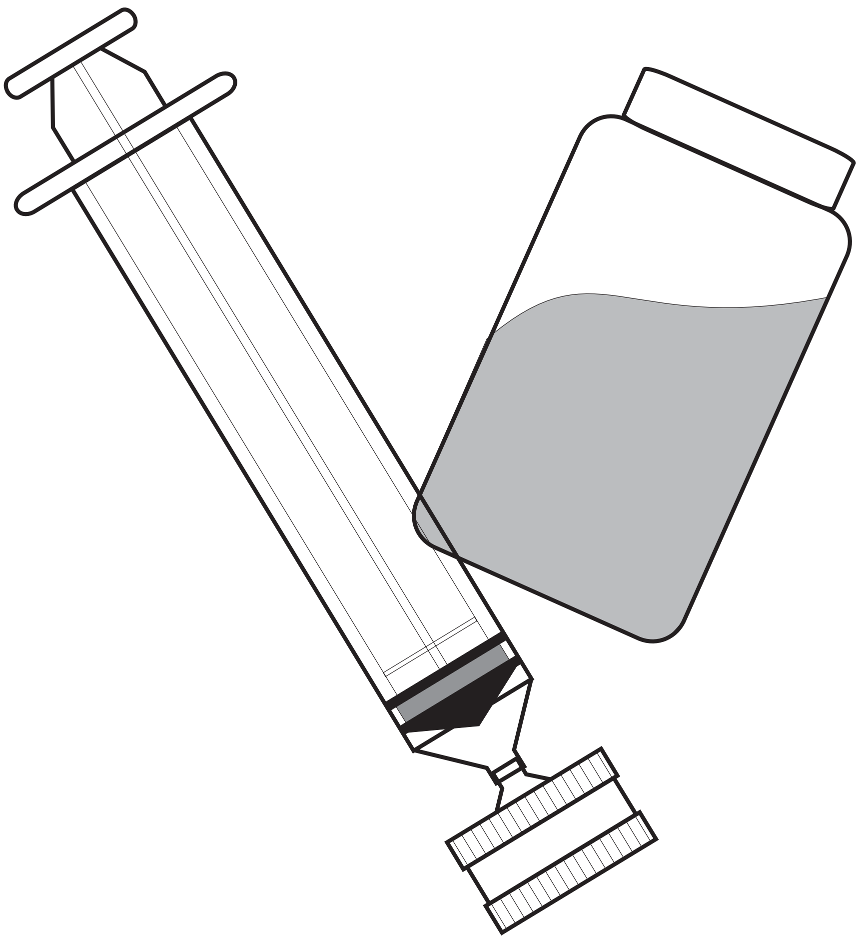
If the sample is higher than 1100 NTU, it must be diluted and retested. See pages 20-22.

PREPARATION OF TURBIDITY FREE WATER

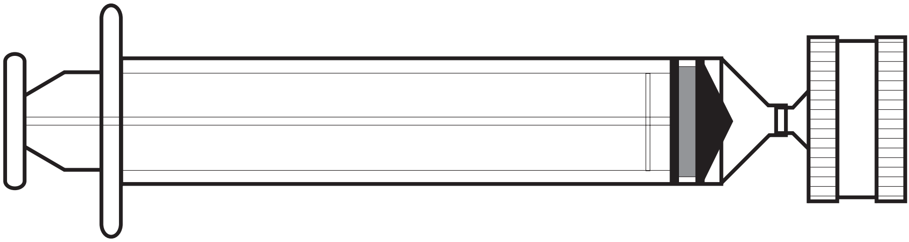
An accessory package (Code 1800, not included) is available for preparing turbidity free water for dilution of high turbidity samples.

The preparation of turbidity free water requires careful technique. Introduction of any foreign matter will affect the turbidity reading. A filtering device with a special membrane filter is used to prepare turbidity-free water. The filter, filter holder, and syringe must be conditioned by forcing at least two syringes full of deionized water through the filtering apparatus to remove foreign matter. The first and second rinses should be discarded. Turbidity-free water as prepared below may be stored in the dark at room temperature in a clean glass bottle with a screw cap and used as required. The storage container should be rinsed thoroughly with filtered deionized water before filling. The water should be periodically inspected for foreign matter in bright light.

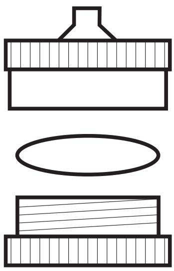
See procedure on next page...



PROCEDURE:

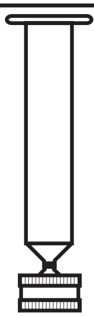


1.



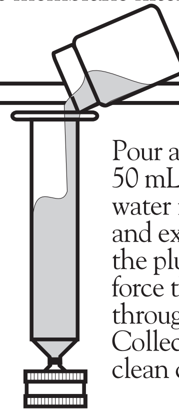
Unscrew the top of the filter holder (0598). (The black O-Ring should remain in the top part of the filter holder). Place a white membrane filter (1103) on the screen inside. Position the filter disk so that it covers the entire surface of the screen. Replace the top of the filter holder and screw on securely. Note: the membrane filters are white and packaged between two blue protective disks. Handle membrane filters with extreme care.

2.



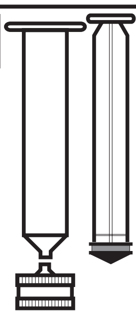
Remove the plunger from the syringe (0943). Attach filter holder to the bottom of the syringe.

3.



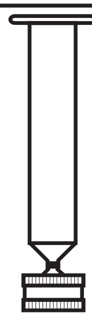
Pour approximately 50 mL of deionized water into the barrel and exert pressure on the plunger to slowly force the water through the filter. Collect water in a clean container.

4.



Remove the filter holder from the syringe, then remove the plunger from the barrel. (This step is required to prevent rupturing the membrane filter by the vacuum as the plunger is removed.)

5.



Replace the filter holder and repeat steps 3 and 4 until the desired amount of turbidity-free water has been collected.

Periodically examine the membrane filter to insure that no holes or cracks are present. Depending on the nature of the unfiltered water, it is possible to prepare a liter or more of turbidity-free water using a single filter. The membrane filter may be stored in the holder indefinitely and used as required.

DILUTION PROCEDURES

If a sample is encountered that is higher than 1100 NTU, a careful dilution will bring the sample into the acceptable range. However, there is no guarantee that halving the concentration will exactly halve the NTU values. The particulates often react in an unpredictable manner when diluted.

TESTING TIPS

1. Samples should be collected in a clean glass or polyethylene container.
2. Samples should be analyzed as soon as possible after collection.
3. Discard tubes that are badly scratched.
4. Gently mix sample by inverting before taking a reading but avoid introducing air bubbles.
5. Turbidity readings will be affected by electric fields around motors.
6. Carbon in the sample will absorb light and cause low readings.
7. Observe shelf life recommendations for turbidity standards.
8. The turbidimeter should be placed on a surface free from vibration. Vibrations can cause high readings.
9. Excessive color in a sample will absorb light and cause high readings. The user should verify if a certain level of color will cause a significant error at the level of turbidity being tested.

PROBLEM	CHECK	ACTION
No Power	Battery	Replace
	AC Adapter	Plug in
	AC Wall Outlet	Verify power source
	Contact LaMotte for Return Authorization	Return to LaMotte for repair
Suspect Calibration	Check calibration with standards	Use new standards
	Verify standards with Formazin	Run alternate test with Formazin
	Verify with another meter	Check other meter calibrations
	Check tube alignment	Re-align tube
	Check sample tubes for dirt and scratches	Check, clean and/or replace if necessary
	Check to see if internal meter components are wet	Always dry tubes before inserting. Examine chamber for visible moisture.
	Reset meter to factory calibration	With meter off, hold down ▼ and press **READ**
	Battery	A fresh battery should be installed at all times, even when using the power adapter. This will ensure that the meter will power down properly and the calibration will not be lost. Return meter for recalibration.
	Contact LaMotte for Return Authorization	Return for calibration check
ER1	Very low battery	Change battery immediately (see pg. 16)
ER2	Over range	Dilute sample
ER3	Burnt out bulb or misaligned tube	Check alignment Call LaMotte
BAT	Low Battery	Change battery

RS232 PORT

The 2020 Turbidimeter may be interfaced with any IBM compatible computer using an Interface cable (Code 1772). The meter may also be interfaced with an RS-232 serial printer, using an appropriate cable and setting the printer configuration to the output below.

Output: RS232 compatible, asynchronous serial, 9600 baud, no parity, 8 data bits, 1 stop bit.

Computer Connection: RS232 interface connection, 8 pin mDIN/9 pin F D-submin.

Pin out:

5	RS-232 TxD
3	RS-232 RxD
4, 6, 8	digital ground

MAINTENANCE

REPLACING THE BATTERY

The LaMotte 2020 uses a standard 9-volt alkaline battery that is available worldwide. A fresh battery should be installed at all times, even when using the power adapter. This will ensure that the meter will power down properly. The battery compartment is located on the bottom of the case. To replace the battery:

1. Open the battery compartment lid
2. Remove the battery and disconnect the battery from the polarized plug.
3. Carefully connect the new battery to the polarized plug and insert it into the compartment.
4. Close the battery compartment lid

REPLACING THE LAMP

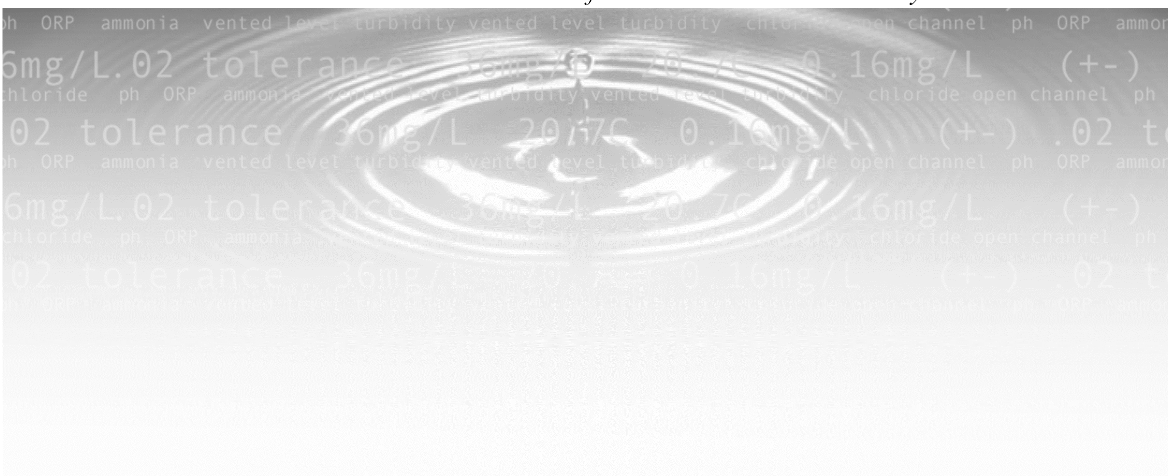
The tungsten lamp included with the model 2020 has a life of approximately 800 hours. If the display becomes unstable when using LaMotte AMCO™ standards, call LaMotte Company for a return authorization number to have the lamp replaced and have the unit examined.

REPAIRS

If it is necessary to return the instrument for repair, telephone LaMotte Company at 1-800-344-3100 or fax 1-410-778-6394 for a return authorization number.

YSI **Environmental**

Pure Data for a Healthy Planet.™



YSI 556 MPS
Multi Probe System

Operations Manual

Contents

1. Safety

1.1 General Safety Information

Read all safety information in this manual carefully before using the YSI 556 Multi-Probe System (MPS). Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*.

⚠ **WARNING**

Warnings are used in this manual when misuse of the instrument could result in death or serious injury to a person.

⚠ **CAUTION**

Cautions are used in this manual when misuse of the instrument could result in mild or serious injury to a person and/or damage to equipment.

⚠ **IMPORTANT SAFETY INSTRUCTIONS!**

⚠ **SAVE THESE INSTRUCTIONS!**

⚠ In essence, the most important safety rule for use of the YSI 556 MPS is to utilize the instrument ONLY for purposes documented in this manual. This is particularly true of the YSI 6117 rechargeable battery pack that contains nickel metal hydride (NiMH) batteries. The user should be certain to read all of the safety precautions outlined below before using the instrument.

⚠ YSI 6117 Rechargeable Battery Pack Safety Information

⚠ **Restrictions on Usage**

1. Never dispose of the battery pack in a fire.
2. Do not attempt to disassemble the YSI 6117 battery pack.
3. Do not tamper with any of the electronic components or the batteries within the battery pack. Tampering with either the electronic circuitry or the batteries will result in the voiding of the warranty and the compromising of the system performance, but, more importantly, can cause safety

hazards which result from overcharging such as overheating, venting of gas, and loss of corrosive electrolyte.

4. Do not charge the battery pack outside the 0–40°C temperature range.
5. Do not use or store the battery at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly in front of heaters.
6. Do not expose the battery pack to water or allow the terminals to become damp.
7. Avoid striking or dropping the battery pack. If the pack appears to have sustained damage from these actions or malfunctions after an impact or drop, the user should not attempt to repair the unit. Instead, contact YSI Customer Service. Refer to *Appendix E Customer Service*.
8. If the battery pack is removed from the YSI 556 MPS, do not store it in pockets or packaging where metallic objects such as keys can short between the positive and negative terminals.

⚠ Precautions for Users with Small Children

Keep the battery pack out of reach of babies and small children.

⚠ Danger Notifications – Misuse creates a STRONG possibility of death or serious injury.

FAILURE TO CAREFULLY OBSERVE THE FOLLOWING PROCEDURES AND PRECAUTIONS CAN RESULT IN LEAKAGE OF BATTERY FLUID, HEAT GENERATION, BURSTING, AND SERIOUS PERSONAL INJURY.

1. Never dispose of the battery pack in a fire or heat it.
2. Never allow the positive and negative terminals of the battery pack to become shorted or connected with electrically conductive materials. When the battery pack has been removed from the YSI 556 MPS, store it in a heavy plastic bag to prevent accidental shorting of the terminals.

3. Never disassemble the battery pack and do not tamper with any of the electronic components or the batteries within the battery pack. The battery pack is equipped with a variety of safety features. Accidental deactivation of any of these safety features can cause a serious hazard to the user.

4. The NiMH batteries in the battery pack contain a strong alkaline solution (electrolyte). The alkaline solution is extremely corrosive and will cause damage to skin or other tissues. If any fluid from the battery pack comes in contact with a user's eyes, immediately flush with clean water and consult a physician immediately. The alkaline solution can damage eyes and lead to permanent loss of eyesight.

⚠ Warning Notifications – Misuse creates a possibility of death or serious injury

1. Do not allow the battery pack to contact freshwater, seawater, or other oxidizing reagents that might cause rust and result in heat generation. If a battery becomes rusted, the gas release vent may no longer operate and this failure can result in bursting.

2. If electrolyte from the battery pack contacts the skin or clothing, thoroughly wash the area immediately with clean water. The battery fluid can irritate the skin.

⚠ Caution Notifications – Misuse creates a possibility of mild or serious injury or damage to the equipment.

1. Do not strike or drop the battery pack. If any impact damage to the battery pack is suspected, contact YSI Customer Service. Refer to *Appendix E Customer Service*.

2. Store the battery pack out of reach of babies and small children.

3. Store the battery pack between the temperatures of -20 and 30°C.

4. Before using the battery pack, be sure to read the operation manual and all precautions carefully. Then store this information carefully to use as a reference when the need arises.

⚠ YSI 616 Cigarette Lighter Charger Safety Information

1. This section contains important safety and operating instructions for the YSI 556 MPS cigarette lighter battery charger (YSI 616; RadioShack Number 270-1533E). BE SURE TO SAVE THESE INSTRUCTIONS.
2. Before using the YSI 616 cigarette lighter charger, read all instructions and cautionary markings on battery charger, battery pack, and YSI 556 MPS.
3. Charge the YSI 6117 battery pack with the YSI 616 cigarette lighter charger ONLY when the YSI 6117 is installed in the YSI 556 MPS.
4. Do not expose charger to rain, moisture, or snow.
5. Use of an attachment not recommended or sold by the battery charger manufacturer may result in a risk of fire, electric shock, or injury to persons.
6. To reduce risk of damage to cigarette lighter and cord, pull by cigarette lighter rather than cord when disconnecting charger.
7. Make sure that the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
8. Do not operate charger with damaged cord or cigarette lighter connector – replace it immediately.
9. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in any way; contact YSI Customer Service. Refer to *Appendix E Customer Service*.
10. Do not disassemble charger other than to change the fuse as instructed. Replace the part or send it to YSI Product Service if repair is required (refer to *Appendix E Customer Service*). Incorrect reassembly may result in a risk of electric shock or fire.
11. To reduce risk of electric shock, unplug charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.

⚠ YSI 556 MPS Water Leakage Safety Information

The YSI 556 MPS has been tested and shown to comply with IP67 criterion, i.e. submersion in 1 meter of water for 30 minutes with no leakage into either the battery compartment or the main case. However, if the instrument is submersed for periods of time in excess of 30 minutes, leakage may occur with subsequent damage to the batteries, the rechargeable battery pack circuitry, and/or the electronics in the main case.

If leakage into the battery compartment is observed when using alkaline C cells, remove batteries, dispose of batteries properly, and dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

If leakage into the battery compartment is observed when using the YSI 6117 rechargeable battery pack, remove the battery assembly and set aside to dry. Return the battery pack to YSI Product Service for evaluation of possible damage. Finally dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** If water has contacted the rechargeable battery pack, do not attempt to reuse it until it has been evaluated by YSI Product Service (refer to *Appendix E Customer Service*). Failure to follow this precaution can result in serious injury to the user.

If it is suspected that leakage into the main cavity of the case has occurred, remove the batteries immediately and return the instrument to YSI Product Service for damage assessment. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** Under no circumstances should the user attempt to open the main case.

2. General Information

2.1 Description

The rugged and reliable YSI 556 MPS (Multi-Probe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multi-parameter system. Featuring a waterproof, impact-resistant case, the YSI 556 MPS simultaneously measures dissolved oxygen, conductivity, temperature, and optional pH and ORP. A simple cellular phone style keypad and large display make the instrument easy to use. The YSI 556 MPS is compatible with YSI EcoWatch™ for Windows™ software.

The YSI 556 MPS assists the user in conforming to Good Laboratory Practice (GLP) standards which help ensure that quality control/quality assurance methods are followed. Battery life is displayed with a fuel gauge, and the user can choose standard alkaline batteries or an optional rechargeable battery pack.

The 1.5 MB memory can store more than 49,000 data sets. Other options include a flow cell and barometer. The internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure.

Features

- Waterproof - meets IP67 specifications
- Field-replaceable DO electrode module; pH and pH/ORP sensors
- Compatible with Ecowatch™ for Windows™ data analysis software
- Assists with Good Laboratory Practice Standards (GLP)
- Choice of DO membrane material for different applications
- Easy-to-use, screw-on cap DO membranes
- User-upgradable software from YSI website
- Three-year warranty on the instrument; one-year on the probe modules
- Available with 4,10, and 20 m cable lengths
- Stores over 49,000 data sets, time and date stamped

- Auto temperature compensating display contrast
- Optional barometer
- Optional rechargeable battery pack or standard alkaline batteries

2.2 Unpacking the Instrument

1. Remove the instrument from the shipping box. Note that the probe module and sensors are shipped in a separate box and will be unpacked later in Section *3.2 Unpacking the Probe Module*.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to *Appendix E Customer Service* or www.ysi.com.

2.3 Features of the YSI 556 Multi-Probe System

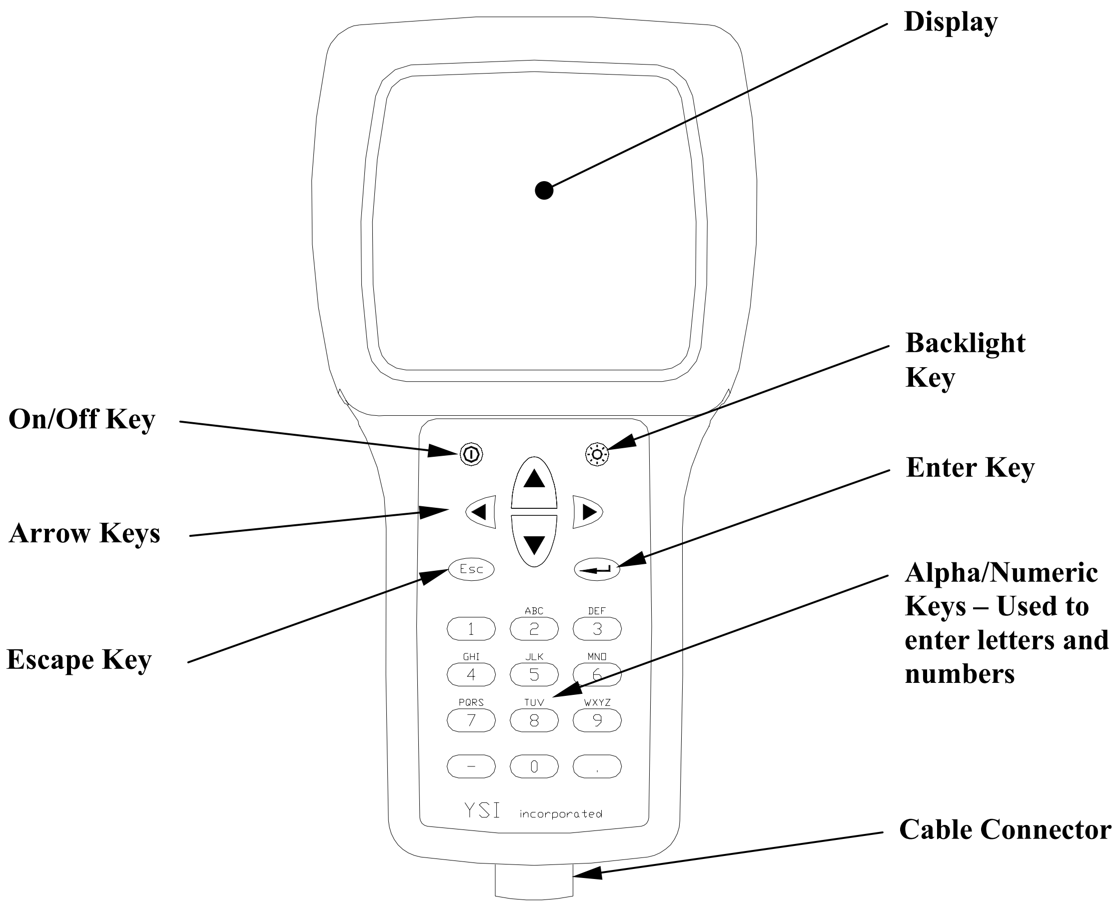


Figure 2.1 Front View of YSI 556 MPS

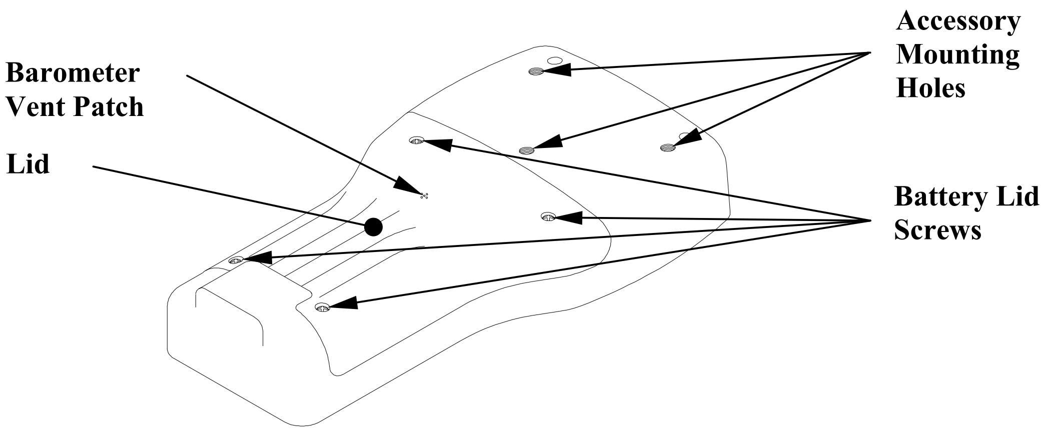


Figure 2.2 Back View of YSI 556 MPS

2.4 Batteries

2.4.1 Battery Life

Standard Alkaline Batteries

With the standard battery configuration of 4 alkaline C cells, the YSI 556 MPS will operate continuously for approximately 180 hours. Assuming a standard usage pattern when sampling of 3 hours of "on time" in a typical day, the alkaline cells will last approximately 60 days.

Optional Rechargeable Battery Pack

When fully charged, the optional rechargeable battery pack will provide approximately 50 hours of battery life.

2.4.2 Inserting 4 C Batteries

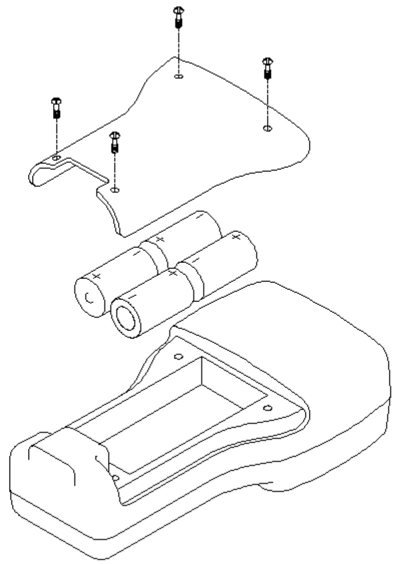


Figure 2.3 Inserting C Cells

⚠ **CAUTION: Install batteries properly to avoid damage to the instrument.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.

2. Remove the battery lid.

3. Insert four C batteries between the clips following the polarity (+ and -) labels on the bottom of the battery compartment.

4. Check gasket for proper placement on the battery lid.

5. Replace the battery lid and tighten the 4 screws securely and evenly.

   NOTE: Do not over-tighten the screws.

2.4.3 Inserting Optional Rechargeable Battery Pack

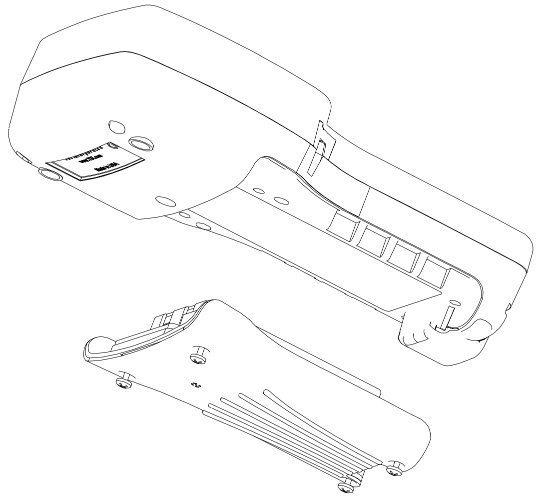


Figure 2.4 Inserting Battery Pack

⚠ **CAUTION: Read all cautions and warnings that come with the battery pack *before* using the battery pack.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.

2. Remove the C battery lid and store for future use. Remove C batteries, if installed.

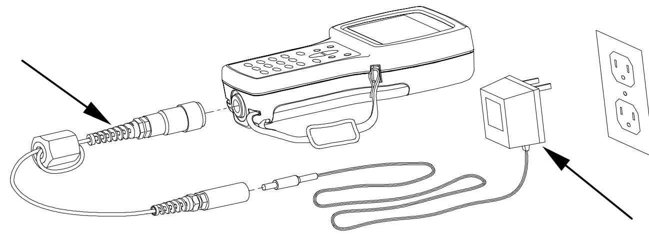
3. Check for proper placement of gasket on the rechargeable battery pack and lid.

4. Install the rechargeable battery pack and lid and tighten the 4 screws securely and evenly.

   NOTE: Do not over tighten the screws.

2.4.4 Charging the Optional Rechargeable Battery Pack

Charger adapter cable (YSI 6119)



Wall power supply (YSI 6114)

Figure 2.5 Charging the Battery Pack

⚠ **CAUTION: Do not use or store the battery pack at extreme temperatures such as in strong direct sunlight, in cars during hot weather or close to heaters.**

1. Install the rechargeable battery pack into the instrument as described in Section *2.4.3 Inserting Optional Rechargeable Battery Pack*.

2. Attach the charger adapter cable (YSI 6119) to the instrument.

   NOTE: Wall power supplies for use in countries outside the US and Canada can be found in *Appendix B Instrument Accessories*.

3. Insert the barrel connector of the wall power supply into the barrel of the adapter cable.

⚠ **CAUTION: Do not charge the battery pack continuously for more than 48 hours.**

⚠ **CAUTION: Do not drop or expose to water.**

⚠ **CAUTION: Do not charge the battery pack at temperatures below 0°C or above 40°C.**

4. Plug the wall power supply into an AC power outlet for approximately 2 hours to obtain an 80% to 90% charge and for 6 hours to get a full charge.

   NOTE: The battery pack can be recharged whether the instrument is on or off.

2.4.5 Storing the Battery Pack

Remove the battery pack from the instrument when the instrument will not be used for extended periods of time to prevent over discharge of the battery pack.

Store the battery pack in a heavy plastic bag to prevent accidental shorting of the terminals. Store between –20 and 30°C.

2.4.6 Optional Cigarette Lighter Charger

⚠ **CAUTION: Read all warnings and cautions that come with the charger before using the charger.**

⚠ **CAUTION: Only use cigarette lighter charger when *rechargeable* battery pack is inserted into instrument.**

⚠ **CAUTION: Do not mishandle cigarette lighter charger. Do not expose to moisture.**

1. Plug the barrel connector of the cigarette lighter charger into the mating end of the YSI 6119 Charger Adapter Cable.

2. Attach the MS-19 end of the YSI 6119 Charger Adapter Cable to the instrument.

3. Make one of the following modifications to the other end of the charger:

   Slide the adapter ring off the plug to use the device with an American or Japanese vehicle.

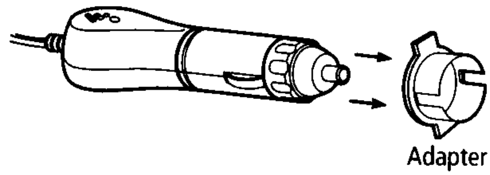


Figure 2.6 Charger Plug Adapter Use

Leave the adapter ring on the plug and position it so that the slots on the adapter ring line up with the plug's spring clips to use the device on a European vehicle.

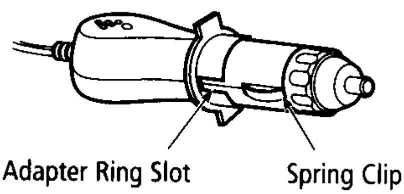


Figure 2.7 European Charger Plug Adapter Use

NOTE: If the charger stops working properly, refer to Section *13 Troubleshooting*.

2.5 Power On

Press and release the on/off button in the upper left corner of the instrument keypad to turn the instrument on or off. See Figure 2.1 Front View of YSI 556 MPS.

2.6 Setting Display Contrast

The display contrast automatically compensates for temperature changes. However, under extreme temperature conditions you may wish to optimize the display by manual adjustment as follows:

1. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “up” arrow to increase (darken) the contrast.

2. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “down” arrow to decrease (lighten) the contrast.

2.7 Backlight

Press and *release* the backlight key in the upper right corner of the keypad to turn the backlight on or off. See Figure 2.1 Front View of YSI 556 MPS.

NOTE: The backlight turns off automatically after two minutes of non-use.

2.8 General Screen Features

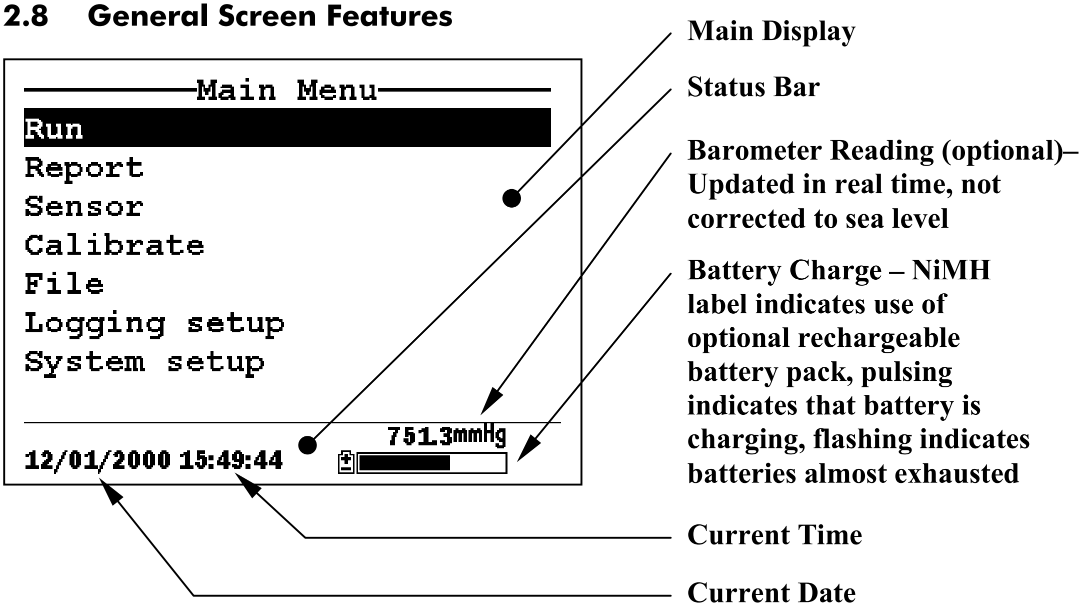


Figure 2.8 Main Menu Screen

2.9 Keypad Use

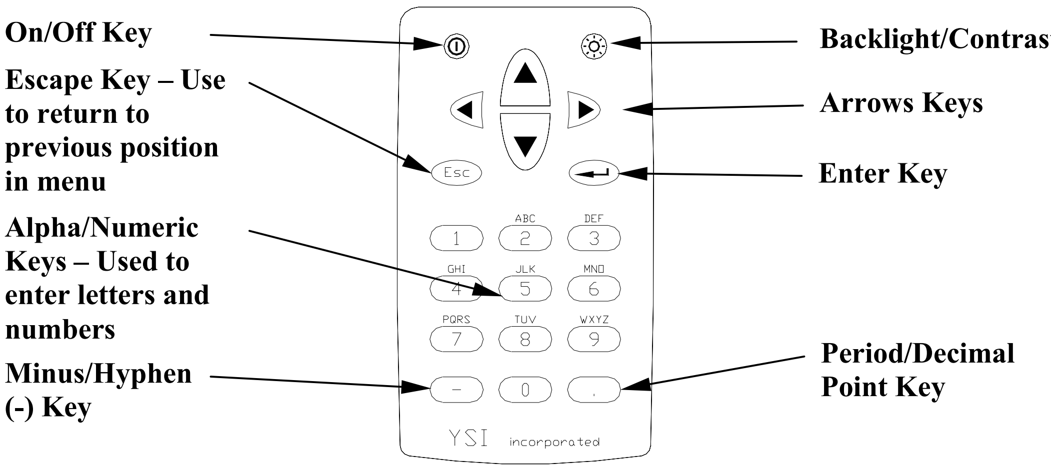


Figure 2.9 Keypad Features

KEY	LETTER/ NUMBER
1	1
2	ABC2abc3
3	DEF3def3
4	GHI4ghi4
5	JKL5jkl5
6	MNO6mno6
7	PQRS7pqrs7
8	TUV8tuv8
9	WXYZ9wxyz9
0	0

Figure 2.10 Keypad Letters & Numbers

1. See Figure 2.10 Keypad Letters & Numbers and press the appropriate key repeatedly until letter or number desired appears in display.

   NOTE: Press the key repeatedly in rapid succession to get to the desired letter or number. If you pause for more than a second, the cursor automatically scrolls to the right to prepare for the next input.

EXAMPLE 1: Press the **6** key *once* and *release* to display an uppercase "M."

EXAMPLE 2: Press the **6** key *four times* and *release* to display the number "6."

EXAMPLE 3: Press the **6** key *five times* and *stop* to display a lowercase "m."

2. Press the left arrow key to go back and reenter a number or letter that needs to be changed.

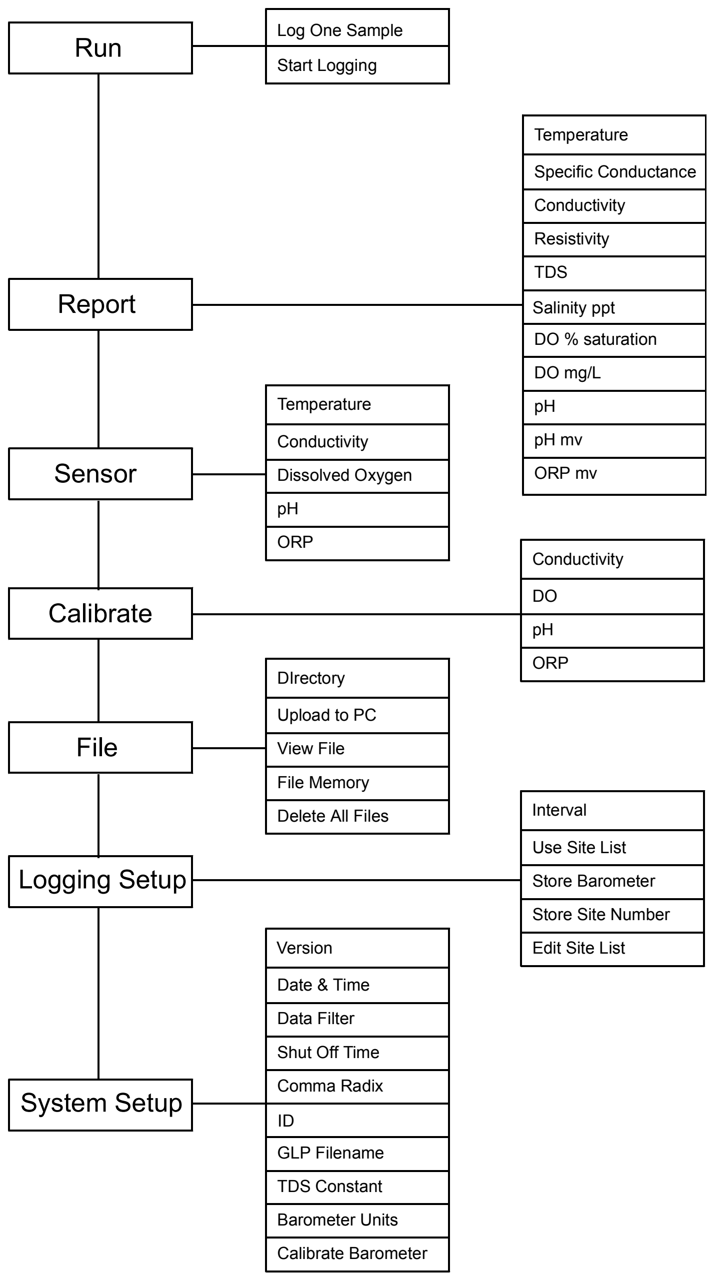
3. Press the **Enter** key when your entry is complete.

   NOTE: The instrument software permits only numeric entries in many instances, such as when setting the clock or entering calibration parameters.

2.10 Instrument Reset

The YSI 556 MPS is characterized by sophisticated software that should provided trouble-free operation. However as with all high-capability software packages, it is always possible that the user will encounter circumstances in which the instrument does not respond to keypad entry. If this occurs, the instrument function can easily be restored by removing and then reapplying battery power. Simply remove either your C-cells or rechargeable battery pack from the battery compartment, wait 30 seconds and then replace the batteries. See Section *2.4 Batteries* for battery removal/reinstallation instructions.

2.11 Menu Flowchart



3. Probe Module

3.1 Introduction

The YSI 5563 Probe module is used for measuring dissolved oxygen, temperature, conductivity, and optional pH and ORP. The probe module is rugged, with the sensors enclosed in a heavy duty probe sensor guard with attached sinking weight. A 4, 10 or 20 meter cable is directly connected to the probe module body making it waterproof. An MS-19 connector at the end of the cable makes the YSI 5563 fully compatible with the YSI 556 Multi-Probe System.

3.2 Unpacking the Probe Module

1. Remove the YSI 5563 Probe module from the shipping boxes.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to *Appendix E Customer Service* or www.ysi.com.

3.3 Features of the YSI 5563 Probe Module

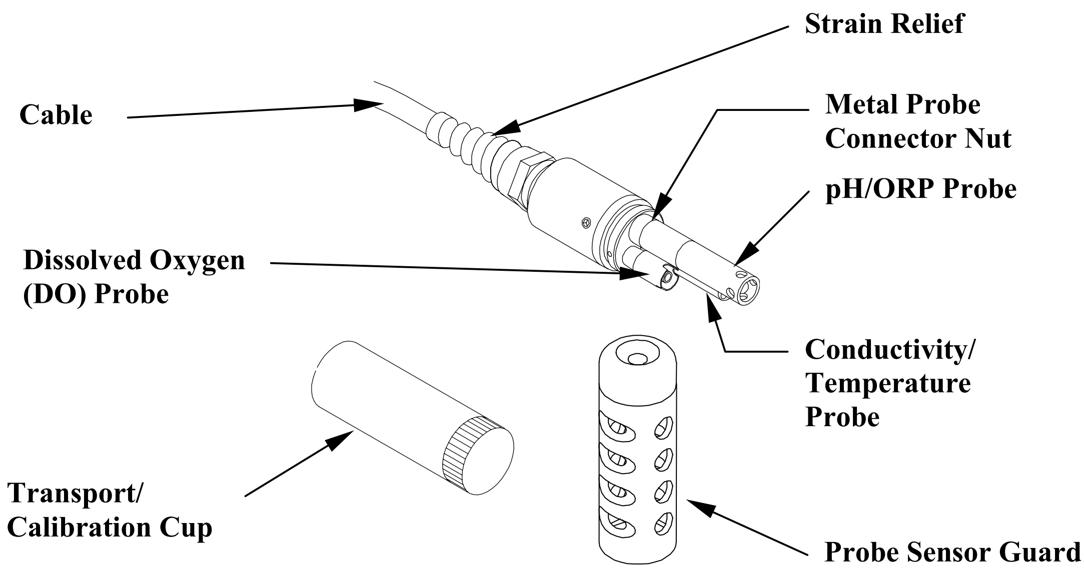


Figure 3.1 Probe Module

3.4 Preparing the Probe Module

To prepare the probe module for calibration and operation, you need to install the sensors into the connectors on the probe module bulkhead. In addition to sensor installation, you need to install a new DO membrane cap.

3.4.1 Sensor Installation

Whenever you install, remove or replace a sensor, it is extremely important that the entire probe module and all sensors be thoroughly dried prior to the removal of a sensor or a sensor port plug. This will prevent water from entering the port. Once you remove a sensor or plug, examine the connector inside the probe module sensor port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, return the probe module to your dealer or directly to YSI Customer Service. Refer to *Appendix E Customer Service*.

Conductivity/Temperature and pH, pH/ORP Sensor Installation

1. Unscrew and remove the probe sensor guard.

2. Using the sensor installation tool supplied in the YSI 5511 maintenance kit, unscrew and remove the sensor port plugs.

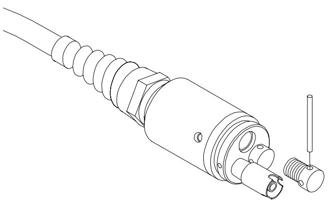


Figure 3.2 Port Plug Removal

3. Locate the port with the connector that corresponds to the sensor that is to be installed.

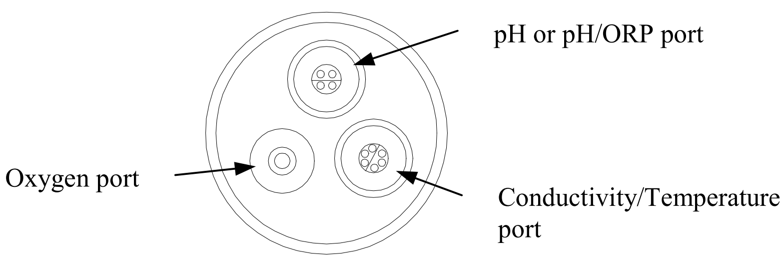


Figure 3.3 Sensor Port Identification

4. Apply a thin coat of o-ring lubricant (supplied in the YSI 5511 maintenance kit) to the o-rings on the connector side of the sensor (see Figure 3.4 O-Ring Lubrication).

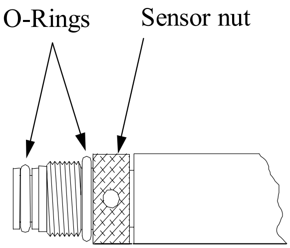


Figure 3.4 O-Ring Lubrication

⚠ **CAUTION:** Make sure that there are NO contaminants between the O-ring and the sensor. Contaminants that are present under the O-ring may cause the O-ring to leak.

5. Be sure the probe module sensor port is free of moisture and then insert the sensor into the correct port. Gently rotate the sensor until the two connectors align.

6. With connectors aligned, screw down the sensor nut using the sensor installation tool.

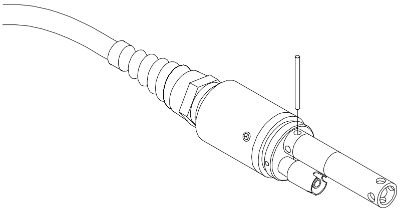


Figure 3.5 Sensor Installation

⚠ **CAUTION:** Do not cross thread the sensor nut. Tighten the nut until it is flush with the face of the probe module bulkhead. Do not over tighten.

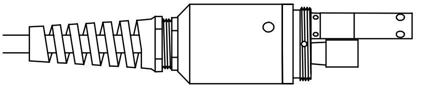


Figure 3.6 Bulkhead Seating

7. Repeat steps 3-6 for any other sensors.

8. Replace the probe sensor guard.

Dissolved Oxygen Sensor Installation

The YSI 5563 comes with the DO sensor already installed. Refer to Section *11.1.2 DO Sensor Replacement* for instructions on installing the YSI 558 Replaceable DO Module Kit.

3.4.2 Membrane Cap Selection

The YSI 5563 is shipped with a YSI 5909 kit that contains membrane caps made with 2 mil polyethylene (PE), a material which should be ideal for most field applications of the 556. However, YSI also offers membrane caps made with two other materials (1 mil polyethylene and 1 mil Teflon) which some users may also prefer. All membranes available for the 556/5563 system provide comparable accuracy if used properly. The difference between the two thicknesses of PE is found in the trade-off of flow dependence and response time as described below. Teflon is offered because some users may prefer to continue using the traditional membrane material used by YSI. To avoid confusion, the membrane caps are color coded as described below and can be ordered in kits as noted:

1 mil Teflon – Black Caps (Kit = YSI 5906)
1 mil Polyethylene (PE) – Yellow Caps (Kit = YSI 5908)
2 mil Polyethylene (PE) – Blue Caps (Kit = YSI 5909)

The 1 mil Teflon caps will offer traditional, reliable performance for most dissolved oxygen applications. The 1 mil PE caps will provide a significantly faster dissolved oxygen response (as long as your 556 Data Filter is set correctly as described below in Sections 10.2 and 10.3.1)) while also giving readings which are significantly less flow dependent than the 1 mil Teflon caps. Finally, 2 mil PE caps will show a large reduction in flow dependence over 1 mil Teflon while not significantly increasing the response time. Generally, one of the PE caps is likely to provide better performance for your application.

IMPORTANT: No matter which type of membrane cap you select, you will also have to confirm your selection in the 556 software from the Sensor menu as described in Section *4 Sensors*.

3.4.3 Membrane Cap Installation

NOTE: The YSI 5563 DO sensor (already installed in the probe module) was shipped dry. A shipping membrane was installed to protect the electrode. **A new membrane cap must be installed before the first use**.

1. Unscrew and remove the probe sensor guard.

2. Unscrew, remove, and discard the old membrane cap.

3. Thoroughly rinse the sensor tip with distilled water.

4. Prepare the electrolyte according to the directions on the electrolyte solution bottle.

5. Hold the new membrane cap and fill it at least 1/2 full with the electrolyte solution.

6. Screw the membrane cap onto the sensor moderately tight. A small amount of electrolyte should overflow.

⚠ **CAUTION:** Do not touch the membrane surface.

7. Screw the probe sensor guard on moderately tight.

3.5 Transport/Calibration Cup

The YSI 5563 Probe module has been supplied with a convenient transport/calibration cup. This cup is an ideal container for calibration of the different sensors, minimizing the amount of solution needed. Refer to Section *6 Calibrate*.

3.5.1 Transport/Calibration Cup Installation

1. Remove probe sensor guard, if already installed.

2. Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body.

3. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not overtighten as this could cause damage to the threaded portions.

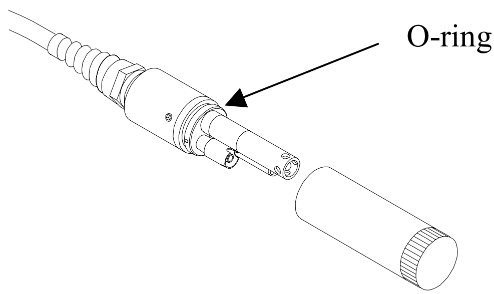


Figure 3.7 Transport/Calibration Cup Installation

3.6 Instrument/Cable Connection

Attach the cable to the instrument as follows:

1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument. See Figure 2.1 Front View of YSI 556 MPS.

2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.

Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.

The Sensors Enabled screen allows the user to enable or disable each of the sensors and select which membrane material will be used for the dissolved oxygen sensor. Disabled sensors will not be displayed on the screen in real time or logged to files.

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

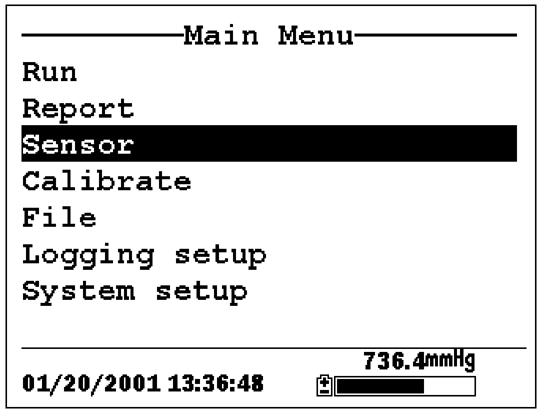


Figure 4.1 Main Menu Screen

3. Use the arrow keys to highlight the **Sensor** selection.

4. Press the **Enter** key to display the sensors enabled screen.

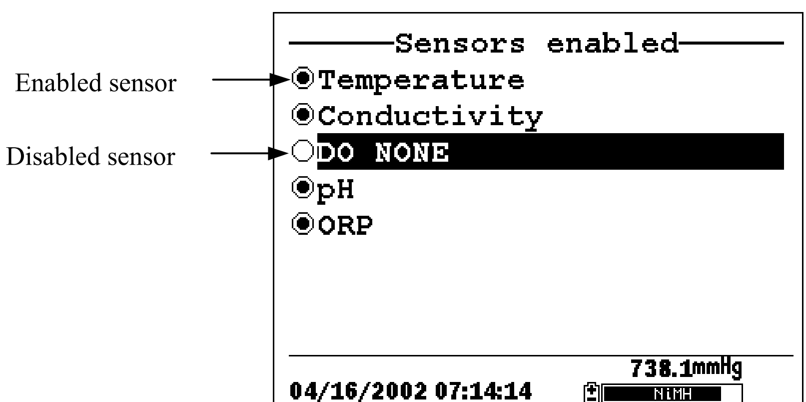


Figure 4.2 Sensors Enabled Screen Before DO Membrane Selection

A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.

Highlight the "DO None" entry as shown above and press **Enter** to display the membrane choice screen. Consult Section *3.4.2 Membrane Cap Selection* for information on the advantages of each type of membrane material. Blue membrane caps using 2 mil polyethylene (PE) were shipped with your YSI 5563 and are likely to be the best choice for most 556 field applications.

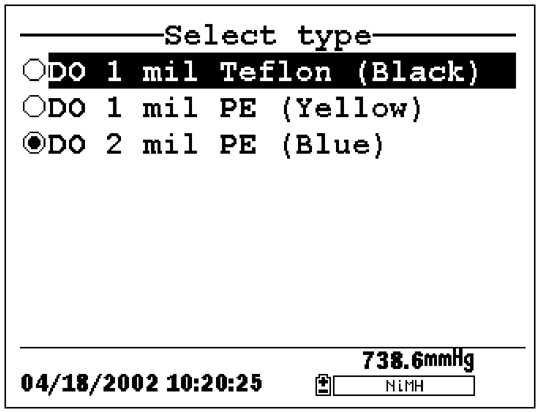


Figure 4.3 Membrane Selection Screen

Highlight the desired membrane choice – in this case, 2 mil PE -- and press Enter to activate your selection with a dot to the left of the screen. Then press **Escape** to return to the Sensor menu that now shows your DO membrane selection.

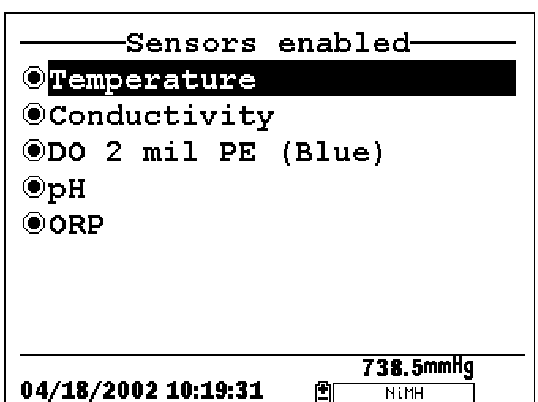


Figure 4.4 Sensors Enabled Screen After DO Membrane Selection

NOTE: The Temperature sensor cannot be disabled. Most other sensors require temperature compensation for accurate readings. In addition, the conductivity sensor must be activated in order to obtain accurate dissolved oxygen mg/L readings.

5. Use the arrow keys to highlight the sensor you want to change, then press the **Enter** key to enable or disable it.

6. Repeat step 5 for each sensor you want to change.

7. Press the **Escape** key to return to the main menu screen.

5. Report

The Report Setup screen allows the user to select which sample parameters and units the YSI 556 MPS will display on the screen. It does NOT determine which parameters are logged to memory. Refer to Section *4 Sensors*.

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

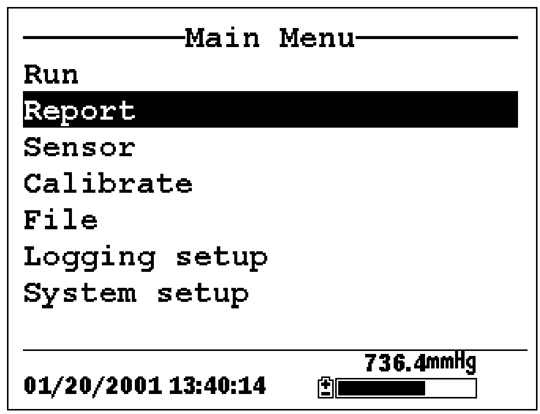


Figure 5.1 Main Menu

3. Use the arrow keys to highlight the **Report** selection.

4. Press the **Enter** key to display the report setup screen.

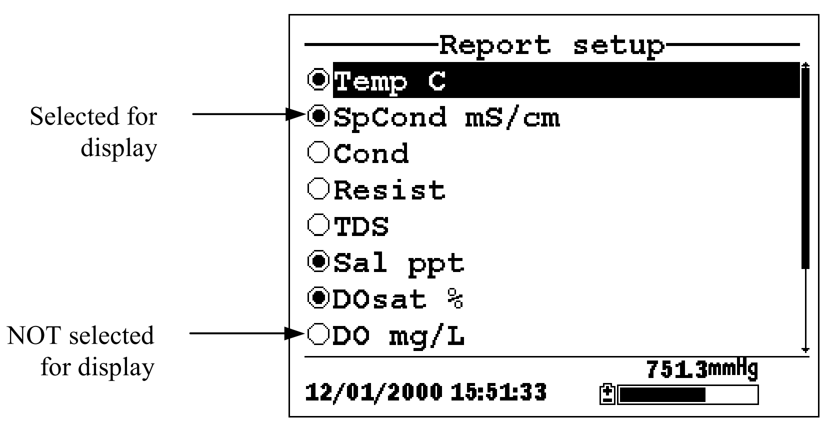


Figure 5.2 Report Setup Screen

NOTE: A black dot to the left of a parameter indicates that parameter is selected for display. Parameters with an empty circle will not be displayed.

NOTE: You may have to scroll down past the bottom of the screen to see all the parameters.

5. Use the arrow keys to highlight the parameter you want to change, then press the **Enter** key. If you can't find the parameter you want, even after scrolling down past the bottom of the screen, the sensor used for that parameter is disabled. Refer to Section *4 Sensors*.

6. If you selected Temperature, Specific Conductivity, Conductivity, Resistance or Total Dissolved Solids, the Units screen will appear.

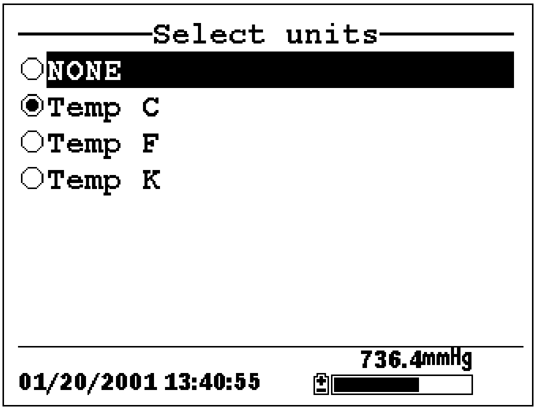


Figure 5.3 Units Screen

7. Use the arrow keys to select the units desired, then press the **Enter** key to return to the report setup screen.

If you selected Salinity, Dissolved Oxygen %, Dissolved Oxygen mg/L, pH, pH mv or ORP mv, the selection dot will simply toggle on or off.

8. Repeat steps 5 and 6 for each parameter you want to change.

NOTE: All parameters may be enabled at the same time.

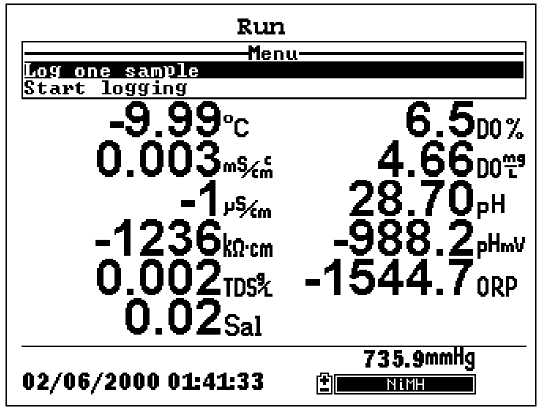


Figure 5.4 All Parameters Displayed

9. Press the **Escape** key to return to the Main menu screen.

6. Calibrate

All of the sensors, except temperature, require periodic calibration to assure high performance. You will find specific calibration procedures for all sensors that require calibration in the following sections. If a sensor listed is not installed in your probe module, skip that section and proceed to the next sensor until the calibration is complete.

⚠ **CAUTION:** Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*. Some calibration standard solutions may require special handling.

6.1 Getting Ready to Calibrate

6.1.1 Containers Needed to Calibrate the Probe Module

The transport/calibration cup that comes with your probe module serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required.

Instead of the transport/calibration cup, you may use laboratory glassware to perform calibrations. If you do not use the transport/calibration cup that is designed for the probe module, you are cautioned to do the following:

- ✓ Perform all calibrations with the Probe Sensor Guard installed. This protects the sensors from possible physical damage.
- ✓ Use a ring stand and clamp to secure the probe module body to prevent the module from falling over. Most laboratory glassware has convex bottoms.
- ✓ Ensure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other sensors (e.g., temperature sensor). The top vent hole of the conductivity sensor must also be immersed during some calibrations.

6.1.2 Calibration Tips

1. If you use the Transport/Calibration Cup for dissolved oxygen (DO) calibration, make certain to loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.
2. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. Use recommended volumes when performing calibrations.
3. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the probe module. You may wish to save old calibration standards for this purpose.
4. Fill a bucket with ambient temperature water to rinse the probe module between calibration solutions.
5. Have several clean, absorbent paper towels or cotton cloths available to dry the probe module between rinses and calibration solutions. Shake the excess rinse water off of the probe module, especially when the probe sensor guard is installed. Dry off the outside of the probe module and probe sensor guard. Making sure that the probe module is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.
6. If you are using laboratory glassware for calibration, you do not need to remove the probe sensor guard to rinse and dry the sensors between calibration solutions. The inaccuracy resulting from simply rinsing the sensor compartment and drying the outside of the guard is minimal.
7. If you are using laboratory glassware, remove the stainless steel weight from the bottom of the probe sensor guard by turning the weight counterclockwise. When the weight is removed, the calibration solutions have access to the sensors without displacing a lot of fluid. This also reduces the amount of liquid that is carried between calibrations.
8. Make certain that port plugs are installed in all ports where sensors are not installed. It is extremely important to keep these electrical connectors dry.

6.1.3 Recommended Volumes

Follow these instructions to use the transport/calibration cup for calibration procedures.

- ✓ Ensure that an o-ring is installed in the o-ring groove of the transport/calibration cup bottom cap, and that the bottom cap is securely tightened.

  NOTE: Do not over-tighten as this could cause damage to the threaded portions.
- ✓ Remove the probe sensor guard, if it is installed.
- ✓ Remove the o-ring, if installed, from the probe module and inspect the installed o-ring on the probe module for obvious defects and, if necessary, replace it with the extra o-ring supplied.
- ✓ Some calibrations can be accomplished with the probe module upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the probe module in the inverted position.
- ✓ To calibrate, follow the procedures in the next section, Calibration Procedures. The approximate volumes of the reagents are specified below for both the upright and upside down orientations.
- ✓ When using the Transport/Calibration Cup for dissolved oxygen % saturation calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8” of water is present in the cup.

Sensor to Calibrate	Upright	Upside Down
Conductivity	55ml	55ml
pH/ORP	30ml	60ml

Table 6.1 Calibration Volumes

6.2 Calibration Procedures

6.2.1 Accessing the Calibrate Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

3. Use the arrow keys to highlight the **Calibrate** selection.

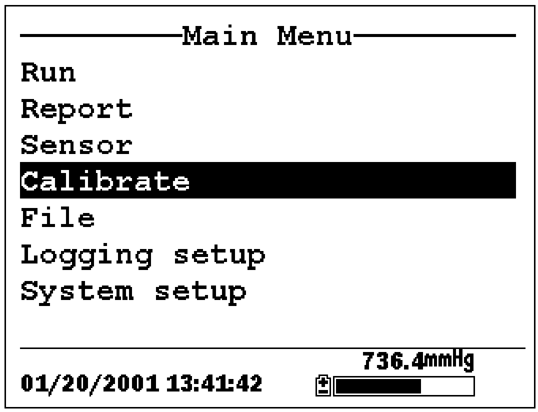


Figure 6.1 Main Menu

4. Press the **Enter** key. The Calibrate screen is displayed.

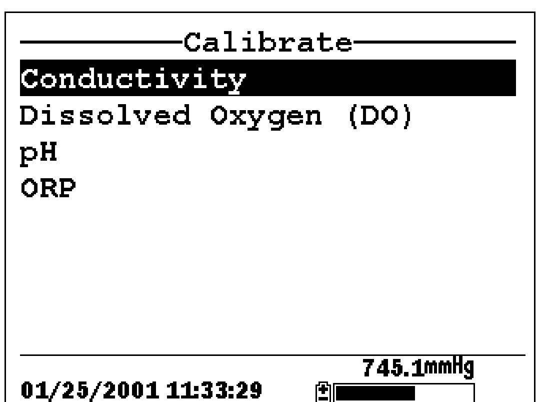


Figure 6.2 Calibrate Screen

6.2.2 Conductivity Calibration

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1. Go to the calibrate screen as described in Section 6.2.1 Accessing the Calibrate Screen.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed.

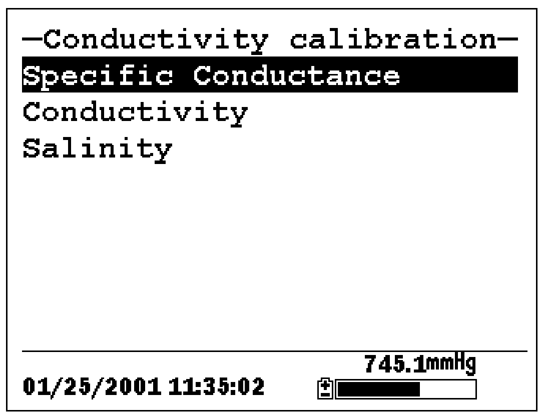


Figure 6.3 Conductivity Calibration Selection Screen

4. Use the arrow keys to highlight the Specific Conductance selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed.

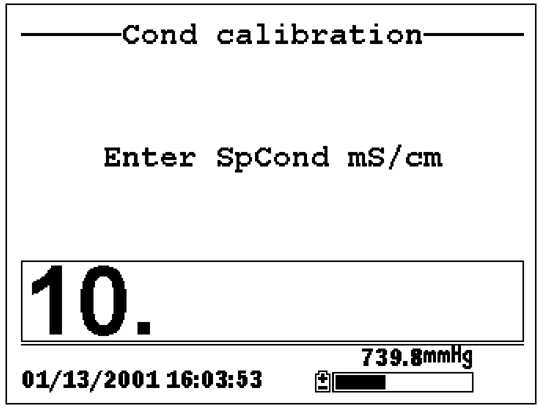


Figure 6.4 Conductivity Calibration Entry Screen

6. Place the correct amount of conductivity standard (see Table 6.1 Calibration Volumes) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the samples you are preparing to measure. However, we do not recommend using standards less than 1 mS/cm. For example:

- ✓ For fresh water use a 1 mS/cm conductivity standard.
- ✓ For brackish water use a 10 mS/cm conductivity standard.
- ✓ For seawater use a 50 mS/cm conductivity standard.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if you are employing standards of low conductivity.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

   NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the vent hole is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not overtighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the standard you are using.

    NOTE: Be sure to enter the value in **mS/cm at 25°C**.

11. Press **Enter**. The Conductivity Calibration Screen is displayed.

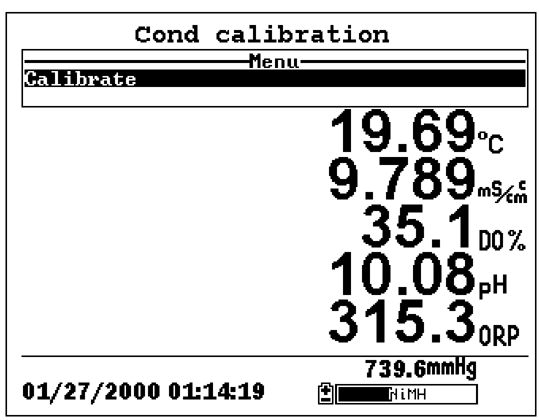


Figure 6.5 Conductivity Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors

will appear on the screen and will change with time as they stabilize.

13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

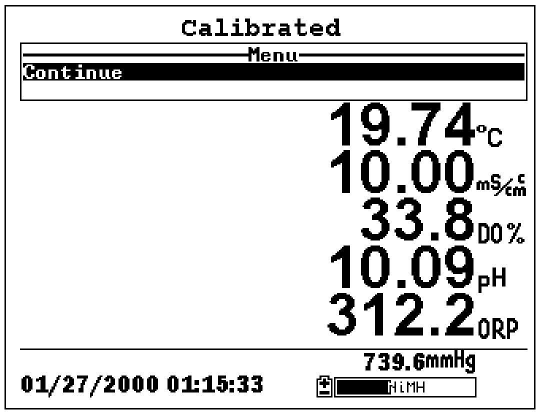


Figure 6.6 Calibrated

14. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen.

15. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

16. Rinse the probe module and sensors in tap or purified water and dry.

6.2.3 Dissolved Oxygen Calibration

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

NOTE: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The dissolved oxygen calibration screen is displayed.

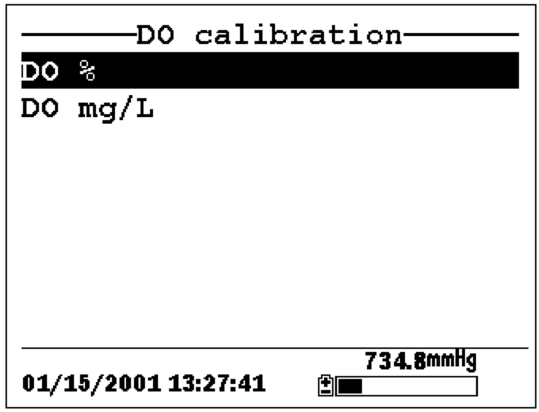


Figure 6.7 DO Calibration Screen

DO Calibration in % Saturation

1. Use the arrow keys to highlight the DO% selection.

2. Press **Enter**. The DO Barometric Pressure Entry Screen is displayed.

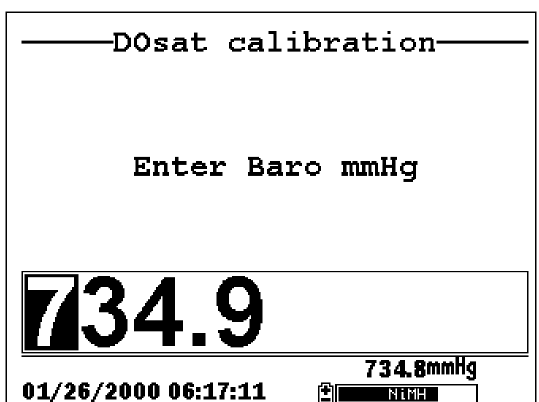


Figure 6.8 DO Barometric Pressure Entry Screen

3. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.

4. Place the probe module into the transport/calibration cup.

   NOTE: Make sure that the DO and temperature sensors are **not** immersed in the water.

5. Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.

6. Use the keypad to enter the current local barometric pressure.

   NOTE: If the unit has the optional barometer, no entry is required.

   NOTE: Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use (refer to Section *10.10 Calibrate Barometer, Step 2*).

7. Press **Enter**. The DO% saturation calibration screen is displayed.

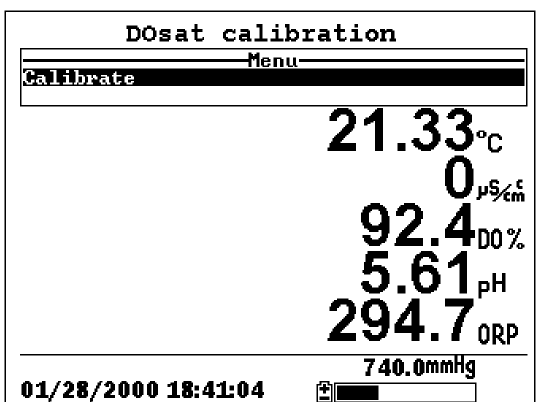


Figure 6.9 DO Sat Calibration Screen

8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for

the temperature to equilibrate before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue. See Figure 6.6 Calibrated.

10. Press **Enter**. This returns you to the DO calibration screen, See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

DO Calibration in mg/L

DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).

1. Go to the DO calibrate screen as described in Section *6.2.3 Dissolved Oxygen Calibration*, steps 1 through 3.

2. Use the arrow keys to highlight the **DO mg/L** selection.

3. Press **Enter**. The DO mg/L Entry Screen is displayed.

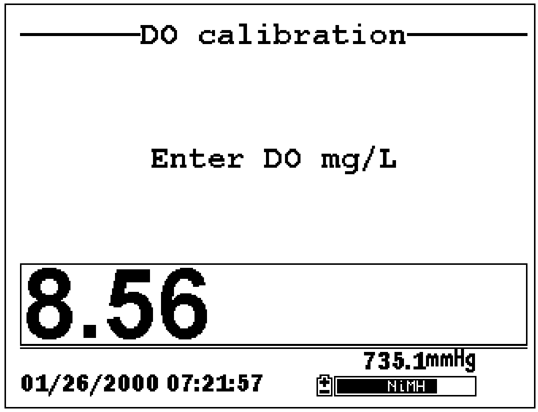


Figure 6.10 DO mg/L Entry Screen

4. Place the probe module in water with a known DO concentration.

   NOTE: Be sure to completely immerse all the sensors.

5. Use the keypad to enter the known DO concentration of the water.

6. Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.

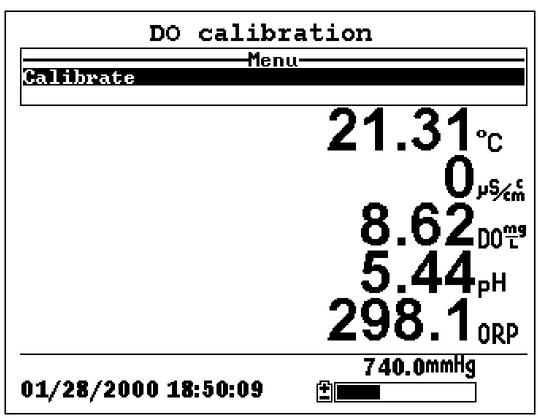


Figure 6.11 DO mg/L Calibration Screen

7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.

8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

10. Press **Enter**. This returns you to the DO calibration screen. See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

6.2.4 pH Calibration

1. Go to the calibrate screen as described in *Section 6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **pH** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The pH calibration screen is displayed.

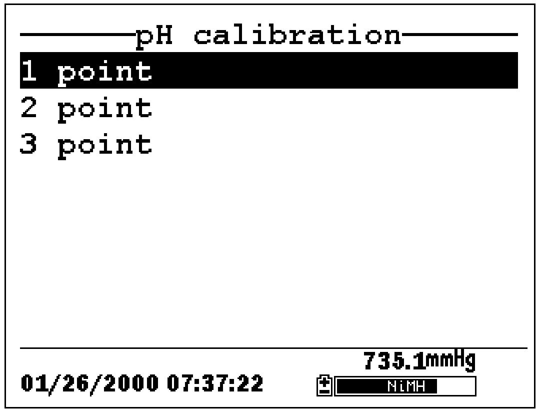


Figure 6.12 pH Calibration Screen

- Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
- Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
- Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the **2-point** selection.

5. Press **Enter**. The pH Entry Screen is displayed.

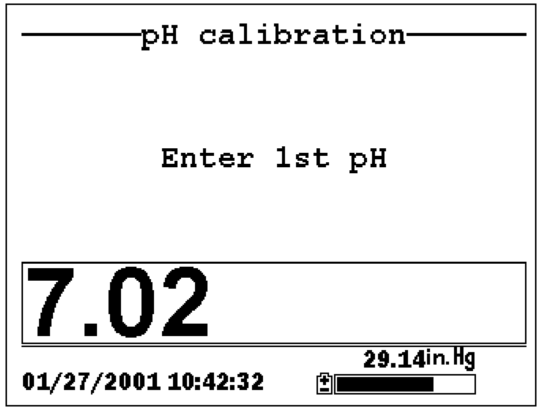


Figure 6.13 pH Entry Screen

6. Place the correct amount (see Table 6.1 Calibration Volumes) of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

9. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not overtighten as this could cause damage to the threaded portions.

10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

11. Press **Enter**. The pH calibration screen is displayed.

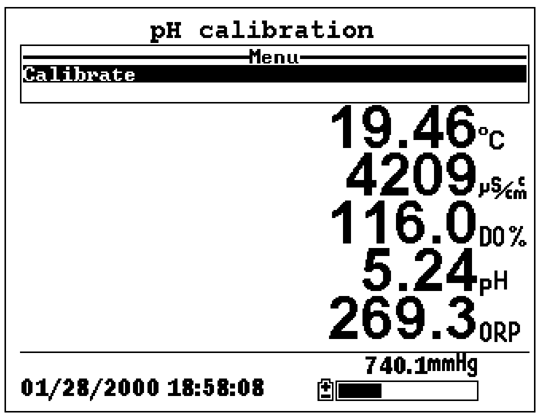


Figure 6.14 pH Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

14. Press **Enter**. This returns you to the Specified pH Calibration Screen, See Figure 6.13 pH Entry Screen.

15. Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.

16. Repeat steps 6 through 13 above using a second pH buffer.

17. Press **Enter**. This returns you to the pH Calibration Screen, See Figure 6.12 pH Calibration Screen.

18. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

19. Rinse the probe module and sensors in tap or purified water and dry.

6.2.5 ORP Calibration

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **ORP** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The ORP calibration screen is displayed.

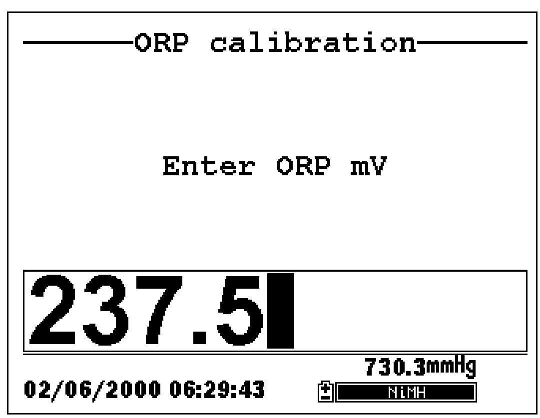


Figure 6.15 Specified ORP Calibration Screen

4. Place the correct amount (see Table 6.1 Calibration Volumes) of a known ORP solution (we recommend Zobell solution) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.

5. Carefully immerse the sensor end of the probe module into the solution.

6. Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes should ensure that the sensor is covered.

7. Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

NOTE: Do not overtighten as this could cause damage to the threaded portions.

8. Use the keypad to enter the correct value of the calibration solution you are using at the current temperature. Refer to Table 6.2 Zobel Solution Values.

Temperature °C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

Table 6.2 Zobel Solution Values

9. Press **Enter**. The ORP calibration screen is displayed.

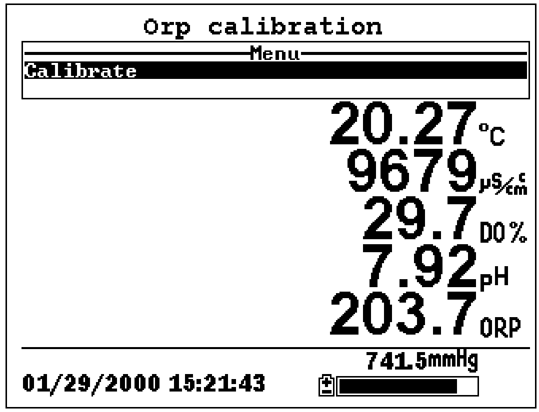


Figure 6.16 ORP Calibration Screen

10. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

NOTE: Verify that the temperature reading matches the value you used in Table 6.2 Zobel Solution Values.

11. Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

12. Press **Enter**. This returns you to the Calibrate Screen. See Figure 6.2 Calibrate Screen.

13. Rinse the probe module and sensors in tap or purified water and dry.

6.3 Return to Factory Settings

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

   NOTE: We will use the Conductivity sensor as an example; however, this process will work for any sensor.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed. See Figure 6.3 Conductivity Calibration Selection Screen.

4. Use the arrow keys to highlight the **Specific Conductance** selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed. See Figure 6.4 Conductivity Calibration Entry Screen.

6. Press and hold the **Enter** key down and press the **Escape** key.

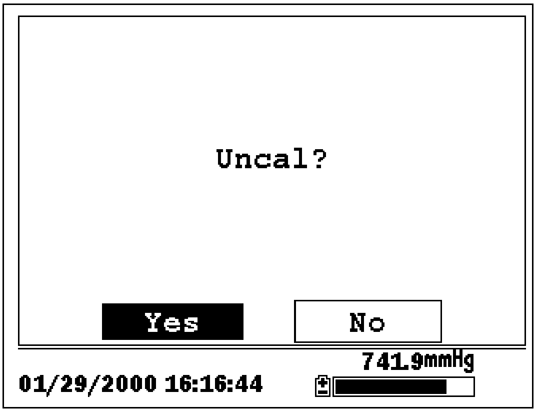


Figure 6.17 ORP Calibration Screen

7. Use the arrow keys to highlight the **YES** selection.

CAUTION: This returns a sensor to the factory settings. For example, in selecting to return specific conductance to the factory setting, salinity and conductivity will automatically return to their factory settings.

8. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen.

9. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

7. Run

The Run screen displays data from the sensors in real-time and allows the user to log sample data to memory for later analysis. Refer to Section *9 Logging* for details on logging sample data.

7.1 Real-Time Data

NOTE: Before measuring samples you must prepare the probe module (refer to Section *3.4 Preparing the Probe Module*), attach the probe module to the instrument (refer to Section *3.6 Instrument/Cable Connection*) and calibrate the sensors (refer to Section *6 Calibrate*).

1. Press the **On/off** key.

OR select Run from the main menu to display the run screen.

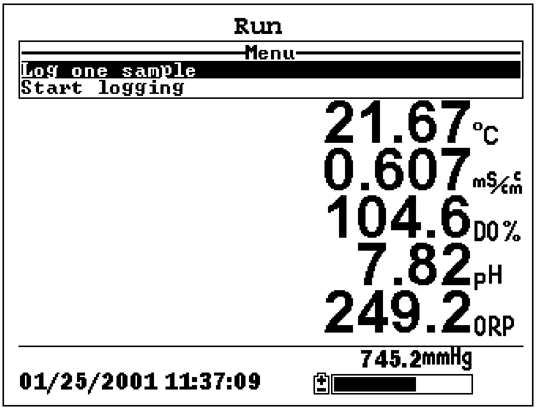


Figure 7.1 Run Screen

2. Make sure the probe sensor guard is installed.

3. Place the probe module in the sample. Be sure to completely immerse all the sensors.

4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.

5. Watch the readings on the display until they are stable.

6. Refer to Section *9 Logging* for instructions on logging sample data.

8. File

The File menu allows the user to view, upload or delete sample data and calibration record files stored in the YSI 556 MPS.

8.1 Accessing the File Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

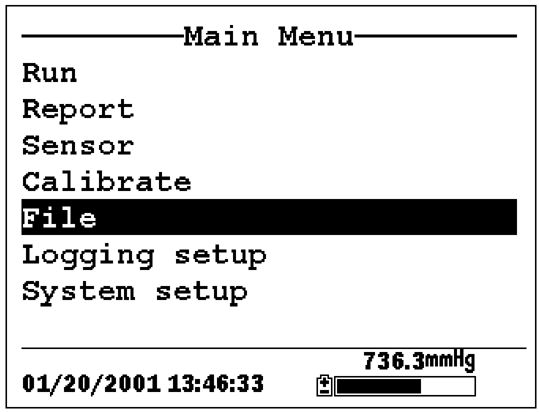


Figure 8.1 Main Menu Screen

3. Use the arrow keys to highlight the **File** selection.

4. Press the **Enter** key. The file screen is displayed.

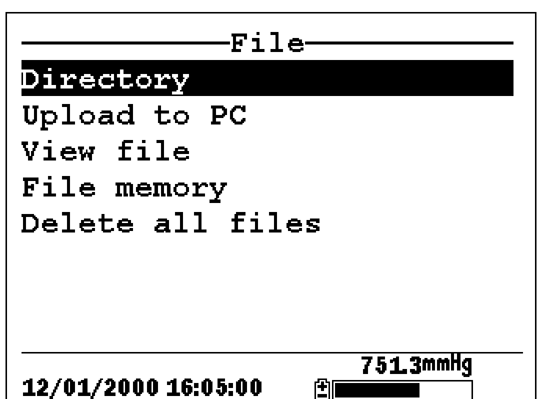


Figure 8.2 File Screen

8.2 Directory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Directory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file list screen is displayed.

   NOTE: Files are listed in the order in which they are logged to memory. Sample Data files have the file extension **.dat**, while Calibration Record files have the file extension **.glp**.

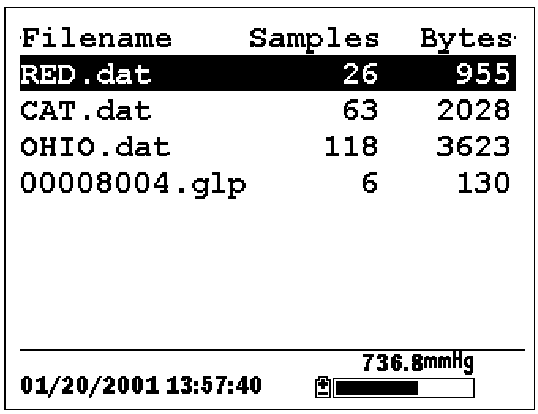


Figure 8.3 File List Screen

4. Use the arrow keys to highlight a file.

5. Press the **Enter** key. The file details screen is displayed.

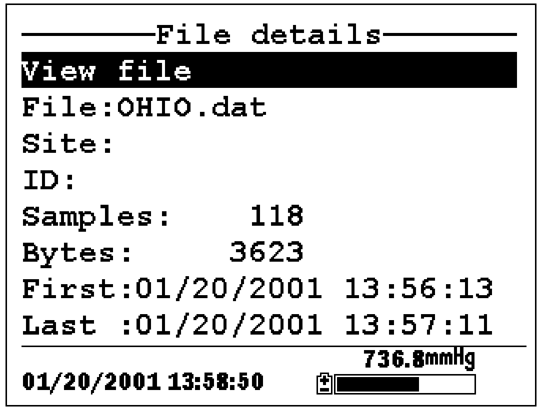


Figure 8.4 File Details Screen

6. Press the **Enter** key to view the file data. Refer to Section *8.3 View File* for details.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.3 View File

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*. See Figure 8.2 File Screen.

2. Use the arrow keys to highlight the **View file** selection.

3. Press the **Enter** key. A list of files is displayed. See Figure 8.3 File List Screen.

4. Use the arrow keys to highlight an individual file.

   NOTE: You may have to scroll down to see all the files.

5. Press the **Enter** key. The file data is displayed with the file name at the top of the display.

   NOTE: If no file name was specified, the data is stored under the default name NONAME1.dat.

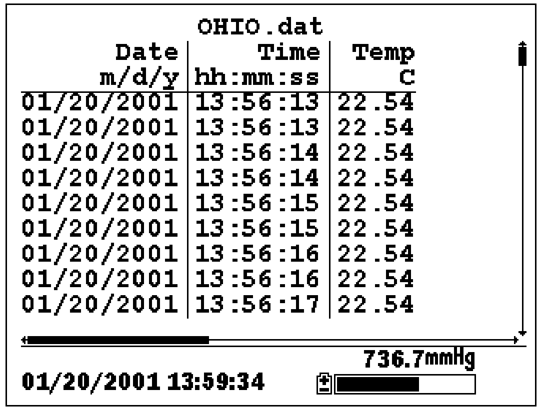


Figure 8.5 File Data Screen

6. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.4 Upload to PC

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. Refer to *Appendix G EcoWatch* for more information. EcoWatch for Windows is available at no cost via a download from the YSI Web Site (www.ysi.com) or by contacting YSI Customer Support. Refer to *Appendix E Customer Service.*

8.4.1 Upload Setup

1. Disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

2. Connect the YSI 556 MPS to a serial (Comm) port of your computer via the 655173 PC Interface cable as shown in the following diagram:

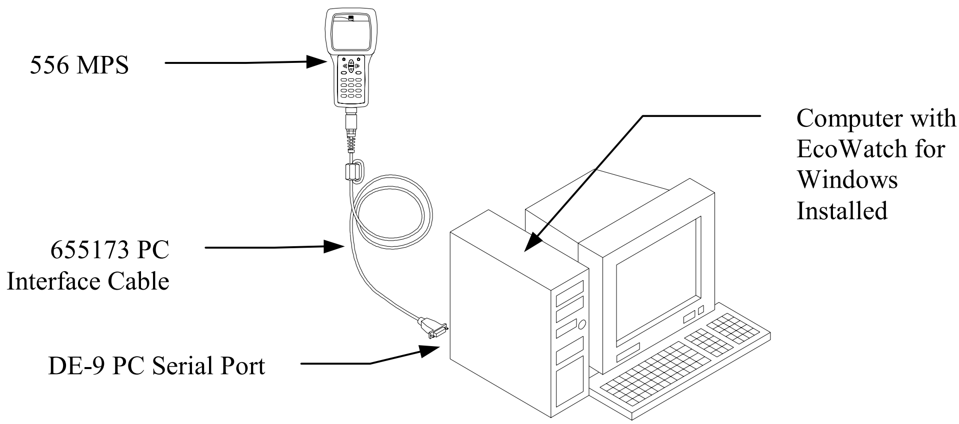


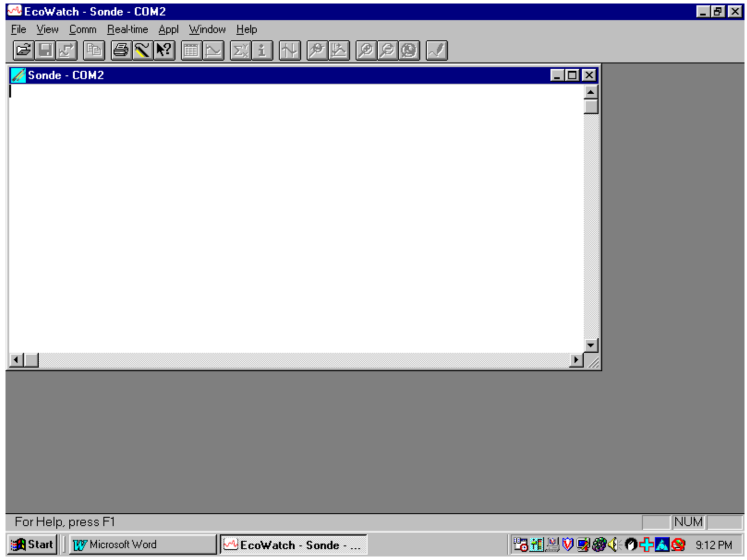
Figure 8.6 Computer/Instrument Interface

3. Open EcoWatch for Windows on your computer.

   NOTE: See *Appendix G EcoWatch* for installation instructions.

4. Click on the sonde/probe icon  in the upper toolbar.

5. Set the Comm port number to match the port the YSI 556 MPS is connected to. After this setup procedure, the following screen will be present on your PC monitor:



8.4.2 Uploading a .DAT File

1. Setup the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the DAT file that you wish to transfer and press **Enter**, both the YSI 556 MPS and PC displays show the progress of the file transfer.

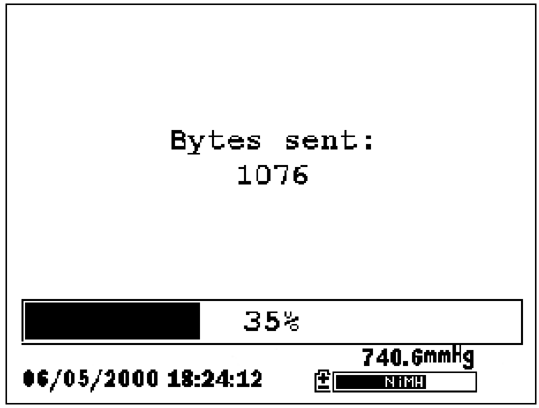
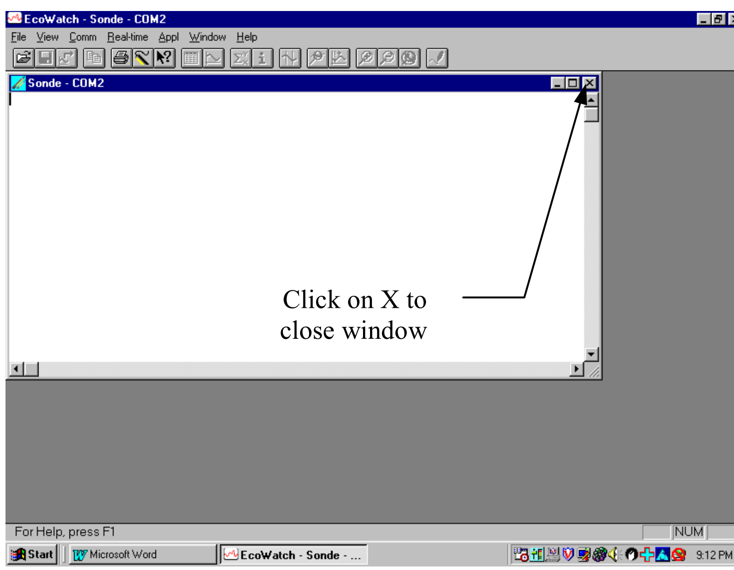


Figure 8.7 File Transfer Progress Screen

NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with a .DAT extension.

6. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the "X" at its upper right corner.



7. Press the **Escape** key on the YSI 556 MPS repeatedly to return to the main menu screen.

8.4.3 Uploading a Calibration Record (.glp) File

For more information on the calibration record, Refer to *Appendix H Calibration Record Information*.

1. Setup up the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the calibration record file that you wish to transfer and press **Enter.**

6. You will then be given a choice of uploading the file in three formats; **Binary, Comma & "" Delimited, and ASCII Text**.

   NOTE: The binary format is reserved for future YSI software packages.

7. Choose an option and press **Enter,** both the YSI 556 and PC displays show the progress of the file transfer.

   NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with the appropriate file extension.

   NOTE: To view the Calibration Record data after upload, simply open the .txt file in a general text editor such as Wordpad or Notepad.

8. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the "X" at its upper right corner.

9. Press the **Escape** key repeatedly to return to the main menu screen.

8.5 File Memory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **File memory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file bytes used screen is displayed.

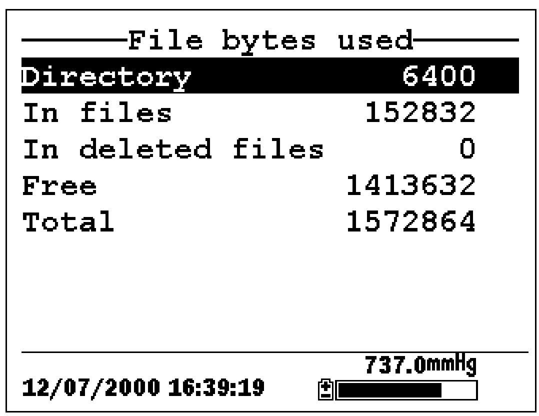


Figure 8.8 File Bytes Used Screen

4. The amount of free memory is listed in line 4 of the file bytes used screen.

   NOTE: If the amount of free memory is low, it may be time to delete all files (after first uploading all data to a PC). Refer to Section *8.6 Delete All Files*.

5. Press the **Escape** key repeatedly to return to the main menu screen.

8.6 Delete All Files

NOTE: It is not possible to delete individual files in order to free up memory. The only way to free up memory is to delete ALL files present. Take care to transfer all files to your computer (refer to Section *8.4 Upload to PC*) *before* deleting them.

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Delete all files** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The Delete all Files screen is displayed.

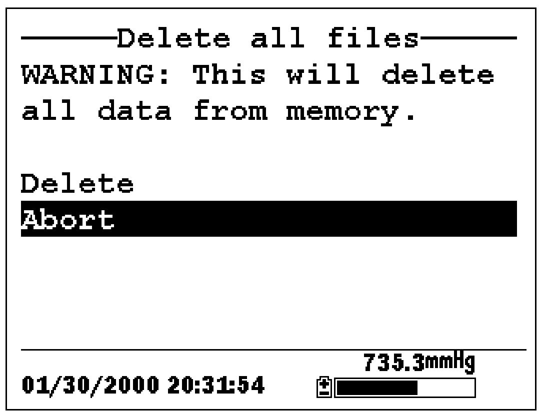


Figure 8.9 Delete All Files Screen

4. Use the arrow keys to highlight the **Delete** selection.

5. Press the **Enter** key.

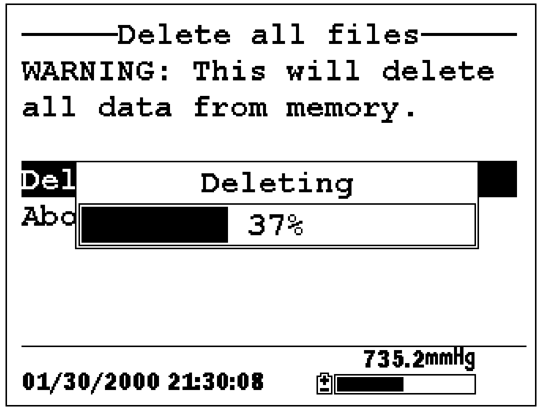


Figure 8.10 Deleting

The progress of file deletion is displayed in bar graph format.

NOTE: Deleting all files in the directory will not change any information in the site list.

6. Press the **Escape** key repeatedly to return to the main menu screen.

9. Logging

9.1 Accessing the Logging Setup Screen

1. Press the **On/off** key to display the run screen.

2. Press the **Escape** key to display the main menu screen.

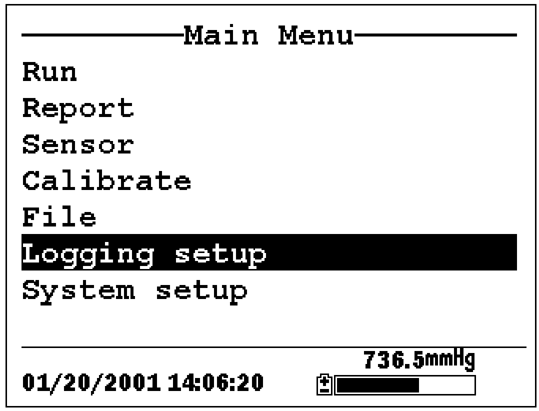


Figure 9.1 Main Menu

3. Use the arrow keys to highlight the **Logging setup** selection.

4. Press the **Enter** key. The logging setup screen is displayed.

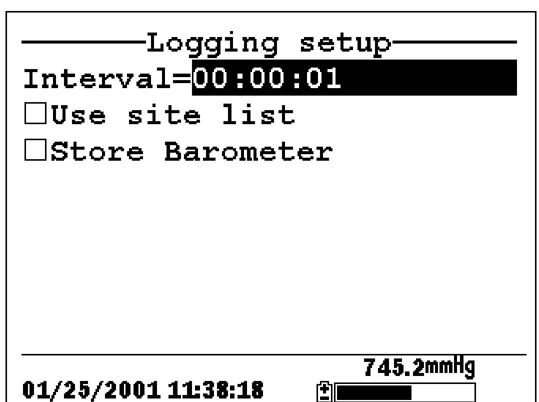


Figure 9.2 Logging Setup Screen

9.2 Setting Logging Interval

Follow steps below to set the interval for logging a data stream.

NOTE: If you do not specify an interval, the instrument will use a default interval setting of 1 second.

NOTE: It is not necessary to set a logging interval when logging a single sample.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.
2. Use the keypad to enter an interval between 1 second and 15 minutes. Refer to Section *2.9 Keypad Use*.

   NOTE: The interval field has hour, minute and second entry fields. Any entry over 15 minutes will change automatically to a 15-minute setting.
3. Press the **Enter** key. The data stream interval is set.
4. Press the **Escape** key repeatedly to return to the main menu screen.

9.3 Storing Barometer Readings

NOTE: The **Store barometer** option is only available on instruments that are equipped with the optional barometer.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.
2. Use the arrow keys to highlight the **Store barometer** selection. See Figure 9.2 Logging Setup Screen.
3. Press the **Enter** key until a check mark is entered in the box next to the store barometer selection if you want to log barometric readings.

   OR press the **Enter** key until the box next to the barometer selection is empty if you do not want to log barometric readings.

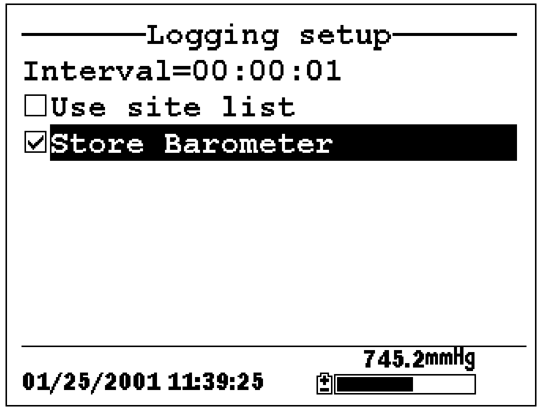


Figure 9.3 Store Barometer

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.4 Creating a Site List

The site list option allows you to define file and site descriptions in the office or laboratory before moving to field logging studies. This is usually more convenient than entering the information at the site and is particularly valuable if you are visiting certain sites on a regular basis. The following section describes how to set up site lists which contain entries designated "Site Descriptions" that will be instantly available to the user in the field to facilitate the logging of data with pre-established naming of files and sites. There are two kinds of **Site Descriptions** available for use in Site lists:

- **Site Descriptions** associated with applications where data from a single site is always logged to a single file. This type is referred to as a "Single-Site Description" and is characterized by two parameters – a file name and a site name. Files logged to YSI 556 MPS memory under a **Single-Site Description** will be characterized primarily by the file name, but will also have the Site name attached, so that it is viewable in either the YSI 556 MPS **File directory** or in EcoWatch for Windows after upload to a PC

- **Site Descriptions** associated with applications where data from <u>multiple sites</u> are logged to a <u>single file</u>. This type is referred to as a "Multi-site Description" and is characterized by three parameters – a file name, a site name, and a site number. Files logged to YSI 556 MPS memory under a **Multi-site Description** are characterized by a file name, but not a site name, since multiple sites are involved. However, each data point has a Site Number attached to it so that the user can easily determine the sampling site when viewing the data from the YSI 556 MPS **File** menu or processing the data in EcoWatch for Windows after upload to a PC.

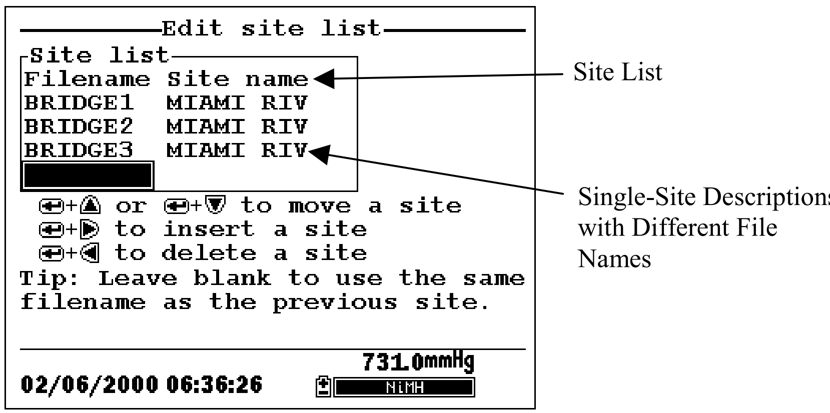


Figure 9.4 Single-Site Descriptions

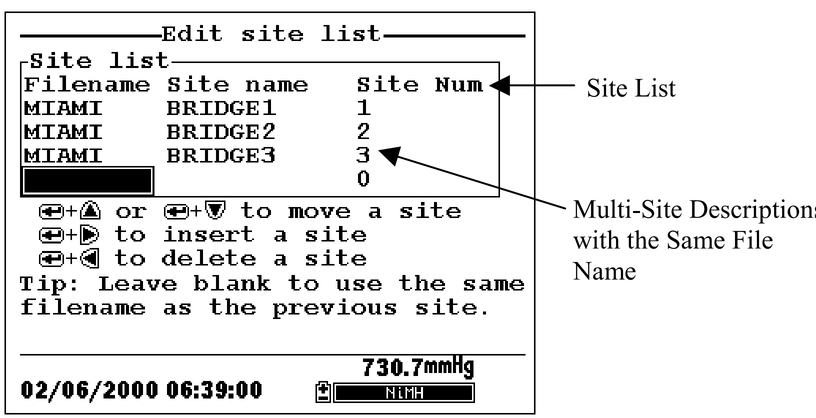


Figure 9.5 Multiple-Site Descriptions

NOTE: Site lists containing Single Site Descriptions are usually input with the designation **Store Site Number** INACTIVE in the YSI 556 MPS **Logging setup** menu. Thus, no site numbers appear in the first **Site list** example. Conversely, **Site lists** containing **Multi-Site Descriptions** MUST be input with the **Store Site Number** selection ACTIVE as shown in the second example.

To create a site list:

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Use site list** selection.

3. Press the **Enter** key. A check mark is entered in the box next to the use site list selection *and* two new entries appear on the logging setup screen. See Figure 9.6 Logging Setup Screen.

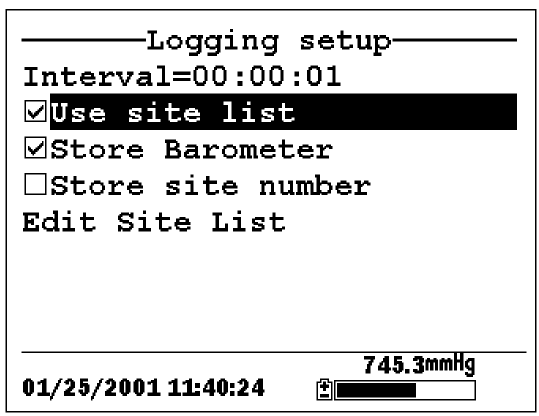


Figure 9.6 Logging Setup Screen

4. Use the arrow keys to highlight the **Store site number** selection.

5. If you are creating Multi-Site Descriptions (which require that the site **number** be stored in your data files), press the **Enter** key until a check mark appears in the box next to the store site number selection.

OR Press the **Enter** key until the box next to the store site number selection is empty, to create Single-Site Descriptions. The site **name** will be stored in the header of your data files.

6. Use the arrow keys to highlight the **Edit site list** selection.

7. Press the **Enter** key. The edit site list screen is displayed. See Figure 9.7 Edit Site List Screen. The **Filename** field is ready for input.

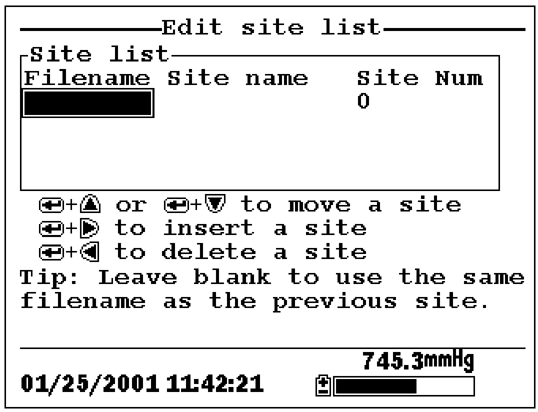


Figure 9.7 Edit Site List Screen

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key. The cursor moves to the right for the entry of a **Site name**.

10. Use the keypad to enter a site name up to 11 characters in length. Refer to Section *2.9 Keypad Use*.

NOTE: If the store site number selection is *not* checked, skip to Step 13.

11. Press the **Enter** key. The cursor moves to the site number entry position.

12. Use the keypad to enter a site number up to 7 characters in length. Refer to Section *2.9 Keypad Use*.

13. Press **Enter**. The cursor moves to the next filename entry position.

14. Repeat Steps 8 to 13 until all filenames and sites have been entered.

15. Press **Escape** repeatedly to return to the main menu screen.

9.5 Editing a Site List

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Edit Site List** selection. See Figure 9.6 Logging Setup Screen.

3. Press the **Enter** key. The edit site list screen is displayed.

4. Edit the site list using the keystrokes described below.

   NOTE: Editing the site list will not have any effect on files stored in the instrument memory.

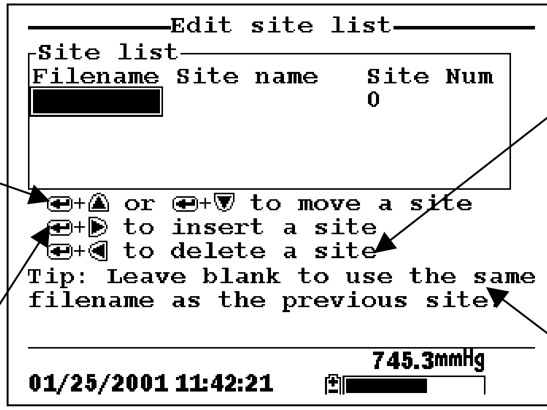


Figure 9.8 Keystrokes for Editing Site List

<u>To MOVE a site:</u> **Use the arrow keys to highlight a site. Press the Up or Down arrow key while holding down the Enter key.**

<u>To INSERT a site above another site:</u> **Use the arrow keys to highlight the site. Press the** Right **arrow key while holding down the** Enter **key. Use keypad to input letters. Refer to Section** ***2.9 Keypad Use*****.**

<u>To DELETE a site:</u> **Use the arrow keys to highlight a site. Press the Left arrow key while holding down the Enter key.**

<u>To use the same file name as the previous site:</u> **Leave the filename blank.**

9.6 Logging Data Without a Site List

1. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

2. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

   OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged.

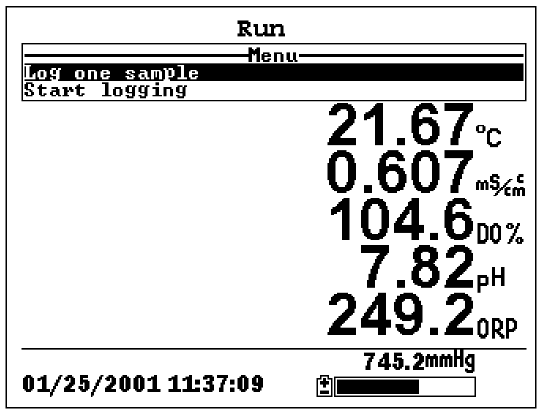


Figure 9.9 Run Screen

3. Press the **Enter** key. The Enter information screen is displayed.

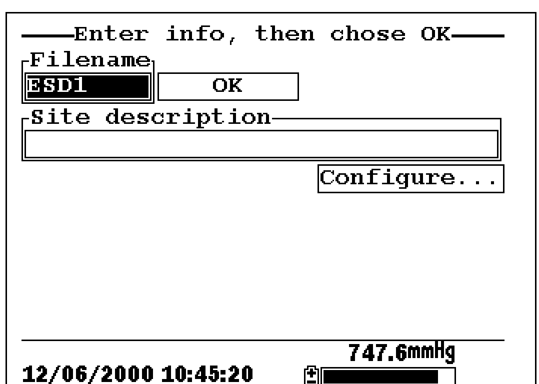


Figure 9.10 Enter Information Screen

NOTE: The last filename used will be displayed.

4. Use the keypad to enter a file name. Refer to Section *2.9 Keypad Use*.

   NOTE: The instrument will assign a default file name of NONAME if no file name is specified.

5. Press the **Enter** key to input the file name.

6. Use the arrow keys to highlight the **Site description** field in the enter information screen.

   NOTE: Entering a Site Description is optional. You may leave the Site Description blank and skip to Step 9.

7. Use the keypad to enter a site description name. Refer to Section *2.9 Keypad Use*.

8. Press the **Enter** key to input the site description.

   NOTE: If you want to change the logging setup, such as sampling interval or storing the barometer reading, use the arrow keys to highlight the **Configure** field, press the **Enter** key, then refer to Section *9.2 Setting Logging Interval* or *9.3 Storing Barometer Readings* for details.

9. Use the arrow keys to highlight the **OK** field in the center of the information screen.

10. Press the **Enter** key to start logging.

    NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

11. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. Skip to Step 13.

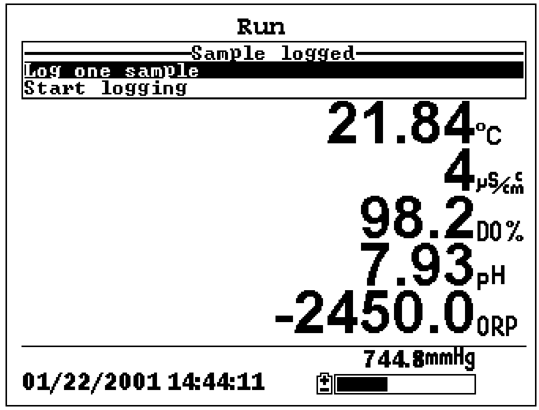


Figure 9.11 Sample Logged Screen

If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**.

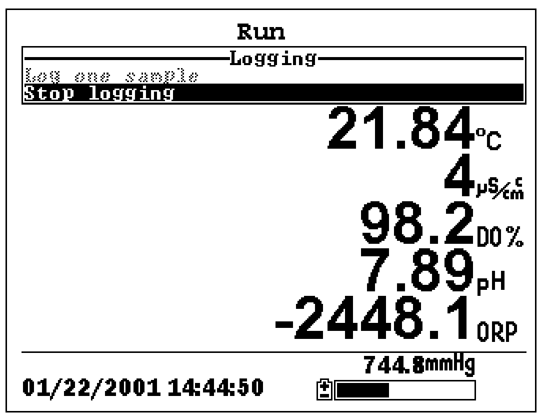


Figure 9.12 Logging Screen

12. At the end of the logging interval, press **Enter** to stop logging.

13. Refer to Section *8.3 View File* to view the data on the instrument display.

9.7 Logging Data With a Site List

1. If you have not already created a site list, refer to Section *9.4 Creating a Site List*.

2. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

3. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

   OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged. See Figure 9.9 Run Screen.

4. Press the **Enter** key. The Pick a site screen is displayed.

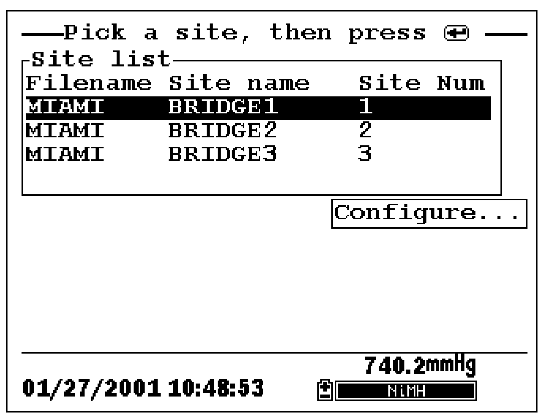


Figure 9.13 Pick a Site Screen

5. Use the arrow keys to highlight the **site** of your choice.

   NOTE: If the site of your choice is grayed out in the site list, refer to Section *9.8 Adding Data to Existing Files*.

   NOTE: Refer to Section *9.5 Editing a Site List* if you want to edit the site list.

6. Press the **Enter** key to start logging.

NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

7. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. See Figure 9.11 Sample Logged Screen. Skip to Step 9.

   If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**. See Figure 9.12 Logging Screen.

8. At the end of the logging interval, press **Enter** to stop logging.

9. Refer to Section *8.3 View File* to view the data on the instrument display.

9.8 Adding Data to Existing Files

In order to add new data to an existing file, the current logging and sensor setup must be *exactly* the same as when the file was created. The following settings must be the same:

- **Sensors enabled** (refer to Section *4 Sensors*)
- **Store Barometer** (refer to Section *9.3 Storing Barometer Readings*)
- **Store Site Number** (refer to Section *9.4 Creating a Site List*)

If the current logging setup is not exactly the same as when the file was created, a parameter mismatch screen is displayed.

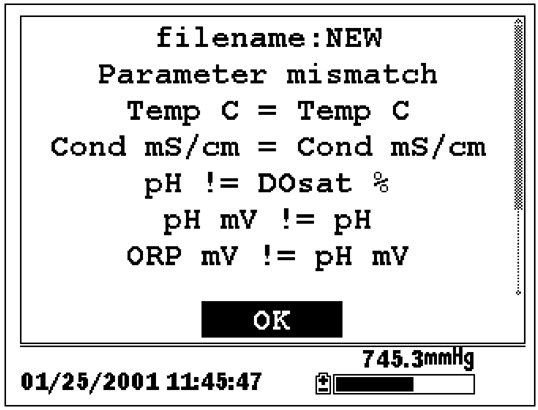


Figure 9.14 Parameter Mismatch Screen

NOTE: The right column shows parameters used when the file was created. The left column shows current parameters.

1. Press the **Down Arrow** key to scroll down and find the mismatch(es).

2. Use the following chart to resolve the mismatch(es).

Mismatch	Action	Reference
Sensor(s) missing from left column	Enable the missing sensor(s)	Section *4 Sensors*
Extra sensor(s) listed in left column	Disable the extra sensor(s)	Section *4 Sensors*
Barometer missing from left column, but present in right column	Enable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Barometer present in left column, but missing from right column	Disable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Store Site Number missing from left column, but present in right column	Enable the Store Site Number setting	Section *9.4 Creating a Site List*
Store Site Number present in left column, but missing from right column	Disable the Store Site Number setting	Section *9.4 Creating a Site List*

3. Return to Section *9.6 Logging Data Without a Site List* or *9.7 Logging Data With a Site List*.

10. System Setup

The YSI 556 MPS has a number of features that are user-selectable or can be configured to meet the user's preferences. Most of these choices are found in the **System setup** menu.

10.1 Accessing the System Setup Screen

1. Press the **On/off** key to display the run screen. See Figure 2.1 Front View of YSI 556 MPS.

2. Press the **Escape** key to display the main menu screen.

3. Use the arrow keys to highlight the **System setup** selection.

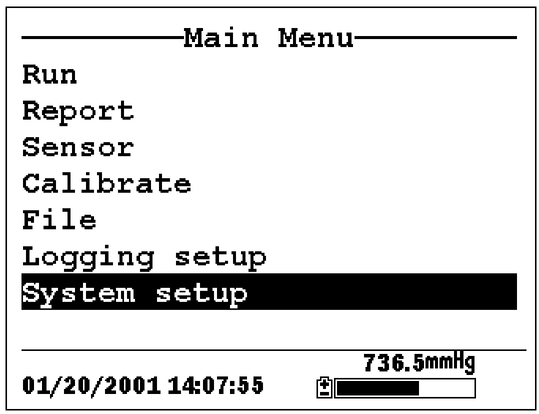


Figure 10.1 Main Menu

4. Press the **Enter** key. The system setup screen is displayed.

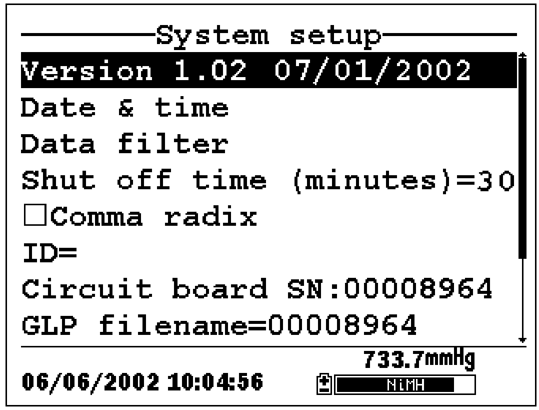


Figure 10.2 System Setup Screen

NOTE: The first line of the **System setup** menu shows the current software version of your YSI 556 MPS. As software enhancements are introduced, you will be able to upgrade your YSI 556 MPS from the YSI Web site. Refer to Section *11.2 Upgrading YSI 556 MPS* Software for details.

10.2 Date and Time Setup

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Date & time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press **Enter**. The date and time setup screen is displayed.

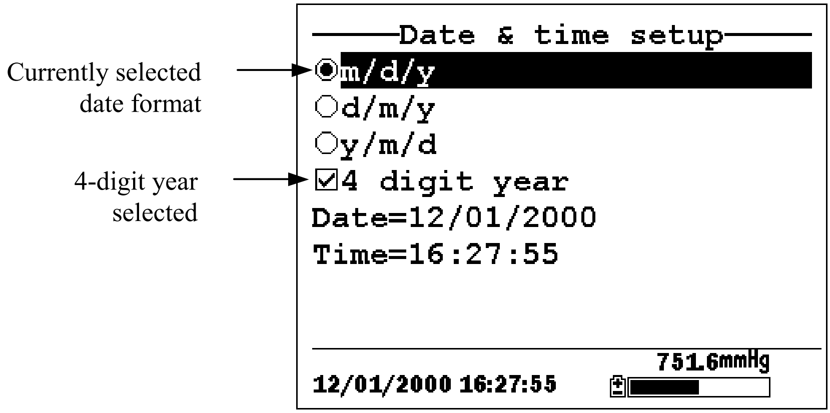


Figure 10.3 Date Setup Screen

NOTE: A black dot to the left of a date format indicates that format is selected.

4. Use the arrow keys to highlight your desired date format.

5. Press **Enter**.

6. Use the arrow keys to highlight the 4-digit year selection.

7. Press **Enter**. A check mark appears in the check box next to the 4-digit year selection.

   NOTE: If unchecked, a 2-digit year is used.

8. Use the arrow keys to highlight the **Date** selection.

9. Press **Enter**. A cursor appears over the first number in the date.

10. Enter the proper number from the keypad for the highlighted date digit. The cursor moves automatically to the next date digit. Refer to Section *2.9 Keypad Use* for more keypad information.

11. Repeat Step 10 until all date digits are correct.

12. Press **Enter** to input the specified date.

13. Use the arrow keys to highlight the **Time** selection.

14. Press **Enter**. A cursor appears over the first number in the time selection.

15. Enter the proper number from the keypad for the highlighted time digit. The cursor moves automatically to the next time digit.

    NOTE: Use military format when entering time. For example, 2:00 PM is entered as 14:00.

16. Repeat Step 15 until all time digits are correct.

17. Press **Enter** to input the correct time.

18. Press the **Escape** key repeatedly to return to the Main menu screen.

10.3 Data Filter

The Data Filter is a software filter that eliminates sensor noise and provides more stable readings.

NOTE: YSI recommends using the default values for the data filter for most field applications.

However, users who are primarily interested in a fast response from their dissolved oxygen sensor should consider a change of the default time constant setting of 8 seconds to one of 2 seconds. This change can be made according to the instructions in Section *10.3.1 Changing the Data Filter Settings* below. The disadvantage of lowering the time constant is that field pH readings may appear somewhat noisy if the cable is in motion.

10.3.1 Changing the Data Filter Settings

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Data filter** selection. See Figure 10.1 Main Menu.

3. Press the **Enter** key. The Data filter setup screen is displayed.

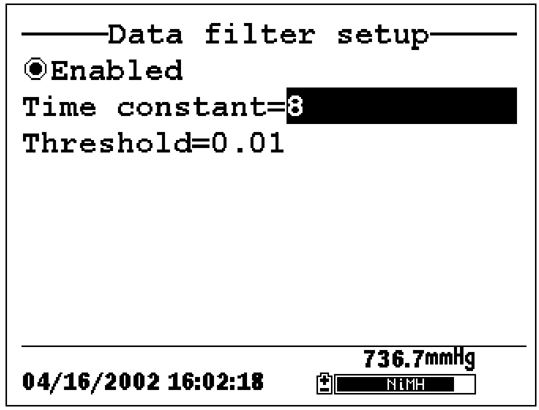


Figure 10.4 Data Filter Screen

4. With Enabled highlighted, press the **Enter** key to Enable or Disable the data filter. A black dot to the left of the selection indicates the data filter is enabled.

5. Use the arrow keys to highlight the **Time constant** field.

   NOTE: This value is the time constant in seconds for the software data filter. Increasing the time constant will result in greater filtering of the data, but will also slow down the apparent response of the sensors.

6. Use the keypad to enter a value. The default value is 8 and this value is ideal for most 556 field applications. As described in Section *10.3 Data Filter* above, users who wish to decrease the response time of the DO readings at the expense of some noise for the pH readings determined concurrently, should change the Time Constant to a value of 2.

7. Press the **Enter** key to enter the time constant.

8. Use the arrow keys to highlight the **Threshold** field.

   NOTE: This value determines when the software data filter will engage/disengage, speeding the response to large changes in a reading. When the difference between two consecutive readings is larger than the threshold, then the reading is displayed unfiltered. When the difference between two consecutive readings drops below the threshold, readings will be filtered again.

9. Use the keypad to enter a value. The default value is 0.01.

10. Press the **Enter** key to enter the threshold.

11. Press the **Escape** key repeatedly to return to the Main menu screen.

10.4 Shutoff Time

The YSI 556 MPS shuts off automatically after 30 minutes of inactivity. The shut off time may be changed as described below.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Shutoff time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Use the keypad to enter a value from 0 to 60 minutes. The default value is 30.

   NOTE: To disable the automatic shutoff feature, enter a zero (0).

4. Press the **Enter** key to enter the correct shutoff time.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.5 Comma Radix

The user can toggle between a period (default) and comma for the radix mark by selecting this item and pressing the **Enter** key as follows:

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Comma radix** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. A check mark appears in the check box next to the comma radix selection indicating that the radix mark is a comma.

10.6 ID

This selection allows you to enter an identification name/number for your YSI 556 MPS. This ID name/number is logged in the header of each file.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **ID** selection. See Figure 10.1 Main Menu.

3. Use the keypad to enter an alphanumeric ID up to 15 characters in length. Refer to Section *2.9 Keypad Use*.

4. Press the **Enter** key to enter the ID.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.7 GLP Filename

This selection allows you to enter a different filename for the YSI 556 MPS Calibration Record file.

NOTE: The default filename is the "556 PC board Serial Number.glp."

6. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

7. Use the arrow keys to highlight the **GLP Filename** selection. See Figure 10.1 Main Menu.

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key to enter the new filename.

Press the **Escape** key repeatedly to return to the main menu screen.

10.8 TDS Constant

This selection allows you to set the constant used to calculate Total Dissolved Solids (TDS). TDS in g/L is calculated by multiplying this constant times the specific conductance in mS/cm.

10.8.1 Changing the TDS Constant

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **TDS Constant** selection. See Figure 10.1 Main Menu.

3. Use the keypad to enter a value. Refer to Section *2.9 Keypad Use*. The default value is 0.65.

4. Press the **Enter** key to enter the correct TDS constant.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.9 Barometer Units

The following information is only for instruments with the barometer option.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Barometer units** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. The Barometer units screen will appear.

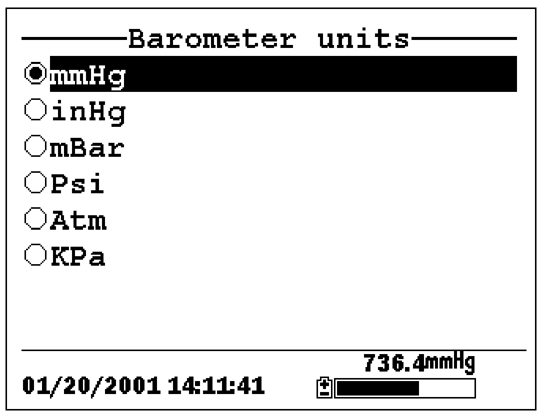


Figure 10.5 Barometer Units Screen

A black dot indicates the currently selected units.

4. Use the arrow keys to highlight your desired barometric unit.

5. Press the **Enter** key to select your choice. A black dot will appear in the circle next to your selected units.

6. Press the **Escape** key repeatedly to return to the main menu screen.

10.10 Calibrate Barometer

The optional barometer has been factory calibrated to provide accurate readings. However, some sensor drift may occur over time, requiring occasional calibration by the user, as follows:

1. Determine your local barometric pressure from an independent laboratory barometer or from your local weather service.

2. If the barometric pressure (BP) reading is from your local weather station, reverse the equation that corrects it to sea level.

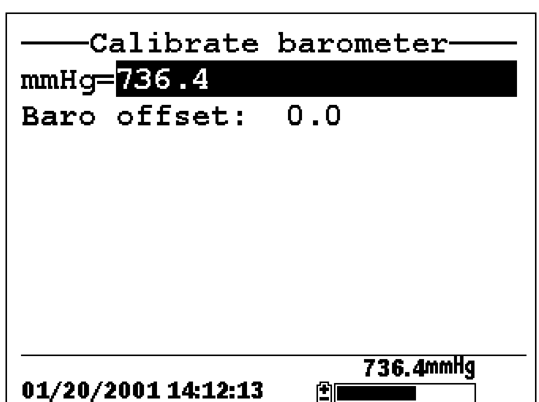
   NOTE: For this equation to be accurate, the barometric pressure units must be in mm Hg.

   True BP = (Corrected BP) – [2.5 * (Local Altitude/100)]

3. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

4. Use the arrow keys to highlight the **Calibrate barometer** selection on the system setup screen. See Figure 10.2 System Setup Screen.

5. Press the **Enter** key. The Calibrate Barometer screen is displayed.



6. Use the keypad to input the known barometric pressure value as determined in Step 2.

7. Press the **Enter** key. The new barometer reading is displayed as well as the approximate offset from the factory reading.

   NOTE: To return the sensor to the factory setting, subtract the offset amount from the current setting and repeat Steps 5 to 7.

8. Press the **Escape** key repeatedly to return to the main menu screen.

11. Maintenance

11.1 Sensor Care and Maintenance

Once the sensors have been properly installed, remember that periodic cleaning and DO membrane changes are required.

11.1.1 DO Sensor

For best results, we recommend that the KCl solution and the membrane cap be changed at least once every 30 days.

1. It is important to recognize that oxygen dissolved in the sample is consumed during sensor operation. It is therefore essential that the sample be continuously stirred at the sensor tip. If stagnation occurs, your readings will be artificially low. Stirring may be accomplished by mechanically moving the sample around the sensor tip, or by rapidly moving the sensor through the sample. The rate of stirring should be at least 1 foot per second.

2. Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the electrolyte solution. The average replacement interval is two to four weeks.

3. If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen producing organisms (e.g. algae), erroneous readings may occur.

4. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the sensor. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.

5. Avoid any environment that contains substances that may attack the probe module and sensor materials. Some of these substances are concentrated acids, caustics, and strong

solvents. The sensor materials that come in contact with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the PVC cable covering.

6. It is possible for the silver anode, which is the entire silver body of the sensor, to become contaminated. This will prevent successful calibration. To restore the anode, refer to Section *11.1.1 DO Sensor, Silver Anode Cleaning.*

7. For correct sensor operation, the gold cathode must always be bright. If it is tarnished (which can result from contact with certain gases), or plated with silver (which can result from extended use with a loose or wrinkled membrane), the gold surface must be restored. To restore the cathode, refer to Section *11.1.1 DO Sensor, Gold Cathode Cleaning.*

8. To keep the electrolyte from drying out, store the sensor in the transport/calibration cup with at least 1/8″ of water.

Silver Anode Cleaning

After extended use, a thick layer of AgCl builds up on the silver anode reducing the sensitivity of the sensor. The anode must be cleaned to remove this layer and restore proper performance. The cleaning can be chemical or mechanical:

Chemical Cleaning: Remove the membrane cap and soak the entire anode section in a 14% ammonium hydroxide solution for 2 to 3 minutes, followed by a thorough rinsing with distilled or deionized water. The anode should then be thoroughly wiped with a wet paper towel to remove the residual layer from the anode.

Mechanical Cleaning: Sand off the dark layer from the silver anode with 400 grit wet/dry sandpaper. Wrap the sandpaper around the anode and twist the sensor. Rinse the anode with clean water after sanding, followed by wiping thoroughly with a wet paper towel.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are still unable to calibrate, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

Gold Cathode Cleaning

For correct sensor operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. The gold cathode can be cleaned by using the adhesive backed sanding disc and tool provided in the YSI 5238 Probe Reconditioning Kit.

Using the sanding paper provided in the YSI 5238 Probe Reconditioning Kit, wet sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. Rinse the cathode with clean water after sanding, followed by wiping thoroughly with a wet paper towel. If the cathode remains tarnished, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation*.

11.1.2 DO Sensor Replacement

1. Remove the probe sensor guard.

⚠ **CAUTION:** Thoroughly dry the sensor so that no water enters the probe module sensor port when the sensor is removed.

2. Insert the long end of the hex key wrench into the small hole in the side of the probe module bulkhead. Turn the wrench counterclockwise and remove the screw. (You do not have to remove the screw all the way to release the sensor.)

3. Pull the old DO sensor module straight out of the probe module body.

   NOTE: The DO sensor is not threaded, it is keyed, so it cannot be removed by twisting.

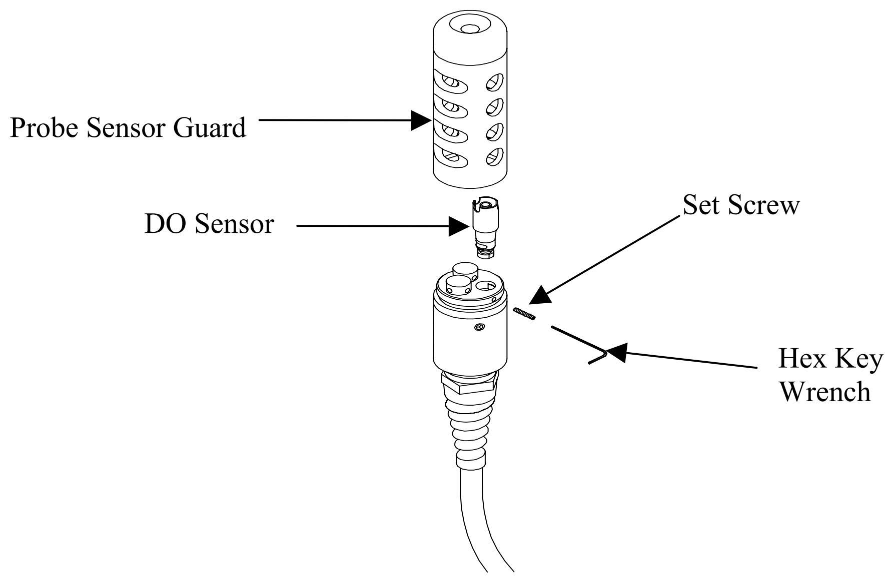


Figure 11.1 DO Sensor Replacement

4. Insert the new DO sensor module. Make sure that the inside of the probe module sensor port and the o-ring on the sensor are clean, with no contaminants, such as grease, dirt, or hair. The DO sensor is keyed, or has a flat side, so that it cannot be aligned improperly.

NOTE: Make sure the DO sensor bottoms out before the set screw is inserted.

5. Insert the set screw into the small hole in the side of the probe module bulkhead, and turn clockwise to rethread.

⚠ **CAUTION:** Make sure that you do not cross-thread the set screw. Use the hex key wrench to tighten the screw in properly, making sure that the screw does not stick out of the side of the probe module bulkhead. The probe sensor guard will not thread on properly and damage may result if the screw is allowed to stick out.

NOTE: The YSI 5563 DO sensor is shipped dry. A shipping membrane was installed to protect the electrode. A new membrane cap must be installed before the first use. Refer to Section *3.4.1 Sensor Installation.*

11.1.3 YSI 5564 pH and 5565 Combination pH/ORP Sensor Cleaning

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these sensors or when the response of the sensor becomes slow.

1. Remove the sensor from the probe module.

2. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (YSI 5564 and YSI 5565) and platinum button (YSI 5565). Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

⚠ **CAUTION:** When using a cotton swab with the YSI 5564 or YSI 5565, be careful NOT to wedge the swab tip between the guard and the glass sensor. If necessary, remove cotton from the swab tip, so that the cotton can reach all parts of the sensor tip without stress.

NOTE: If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 10-15 minutes in clean water containing a few drops of commercial dishwashing liquid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the cleaning solution.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water.

NOTE: If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the acid.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water. To be certain that all traces of the acid are removed from the sensor crevices, soak the sensor in clean water for about an hour with occasional stirring.

NOTE: If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the sensor for approximately 1 hour in a 1 to 1 dilution of commercially available chlorine bleach.

2. Rinse the sensor with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the sensor for period of time longer than 1 hour in order to be certain that all traces of chlorine bleach are removed.) Then re-rinse the sensor with clean water and retest.`

11.1.4 Temperature/Conductivity Sensor Cleaning

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it. The small cleaning brush included in the YSI 5511 Maintenance Kit is ideal for this purpose.

To clean the conductivity cell:

1. Dip the brush in clean water and insert it into each hole 15-20 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

NOTE: In the event that deposits have formed on the electrodes, perform the following additional procedure:

1. Use a mild detergent solution in combination with the brush. Dip the brush in the solution and insert it into each hole 15-20 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

   NOTE: After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

   NOTE: If this procedure is unsuccessful, or if sensor performance is impaired, it may be necessary to return the sensor to a YSI authorized service center for service, Refer to *Appendix E Customer Service*.

   The temperature portion of the sensor requires no maintenance.

11.2 Upgrading YSI 556 MPS Software

1. Access the YSI Environmental Software Downloads page as described in *Appendix G EcoWatch* Step 1 through 3.

2. Click on the **YSI Instruments Software Updates** link (or scroll down until you see YSI 556 MPS).

3. Click on the file icon to the right of the **YSI 556 MPS** listing and save the file to a temporary directory on your computer.

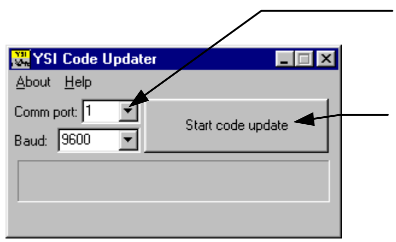
4. After the download is complete, run the file (that you just downloaded) and follow the on screen instructions to install the YSI Code Updater on your computer. If you encounter difficulties, contact YSI customer service for advice. Refer to *Appendix E Customer Service*.

5. If necessary, disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

6. Connect the YSI 556 MPS to a serial port of your computer via the 655173 PC interface cable. See Figure 8.6 Computer/Instrument Interface.

7. Press the **On/off** key on the YSI 556 MPS to display the run screen.

8. Run the YSI Code Updater software that you just installed on your computer. The following window will be displayed:

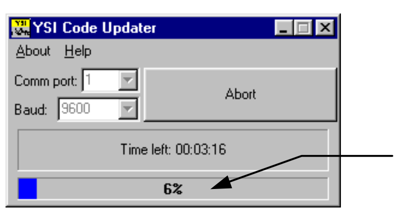


Select Comm port

Click on Start code update

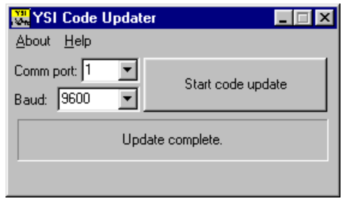
9. Set the Comm port number to match the port that you connected the 655173 PC Interface Cable to, then click on the **Start Code Update button**.

The YSI 556 MPS screen will blank out and a progress indicator will be displayed on the PC.



Progress Indicator

When the update is finished (indicated on the PC screen), the YSI 556 MPS will return to the Run screen. See Figure 7.1 Run Screen.



10. Close the YSI Code Updater window (on the PC) by clicking on the "X" in the upper right corner of the window.

11. Disconnect the YSI 556 MPS from the 655173 PC interface cable and reconnect it to the YSI 5563 Probe Module. Refer to Section *3.6 Instrument/Cable Connection*.

12. Storage

Proper storage between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next application.

12.1 General Recommendations for Short Term Storage

No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid. Immersing them could cause some of them to drift or result in a shorter lifetime.

YSI recommends that short term storage of all multi-parameter instruments be done by placing approximately 1/2 inch of tap water in the transport/calibration cup that was supplied with the instrument, and by placing the probe module with all of the sensors installed into the cup. The use of a moist sponge instead of a 1/2 inch of tap water is also acceptable, as long as its presence does not compromise the attachment of the cup to the probe module. The transport/calibration cup should be sealed to prevent evaporation.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

NOTE: If the storage water (tap water) is accidentally lost during field use, environmental water can be used.

12.2 General Recommendations for Long Term Storage

12.2.1 Probe Module Storage

1. Remove the pH or pH/ORP sensor from the probe module and store according to the individual sensor storage instructions found in Section *12.2.2 Sensor Storage*.

2. Seal the empty port with the provided port plug.

NOTE: Leave the conductivity/temperature sensor and dissolved oxygen sensor, with membrane cap still on, in the probe module.

3. Place 1/2″ of water, deionized, distilled or tap, in the transport/calibration cup.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

4. Insert the probe module into the cup.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

12.2.2 Sensor Storage

Temperature/Conductivity Sensor

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the thermistor and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage. Refer to Section *11.1.4 Temperature/Conductivity Sensor Cleaning.*

pH and Combination pH/ORP Sensor

The key to sensor storage is to make certain that the reference electrode junction does not dry out. Junctions which have been allowed to dry out due to improper storage procedures can usually be rehydrated by soaking the sensor for several hours (overnight is recommended) in a solution which is 2 molar in potassium chloride. If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore sensor function. However in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement.

⚠ **CAUTION:** Do not store the sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

1. Remove the pH or pH/ORP sensor from the probe module.

2. Seal the empty port with the provided port plug.

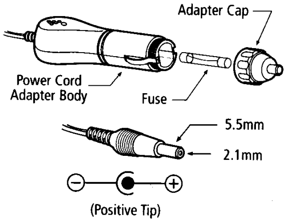
3. Place the sensor in the storage vessel (plastic boot or bottle) which was on the sensor at delivery. The vessel should contain a solution which is 2 molar in potassium chloride.

   NOTE: Make certain that the vessel is sealed to prevent evaporation of the storage solution.

13. Troubleshooting

The following sections describe problems you may encounter when using the YSI 556 MPS and provides suggestions to overcome the symptom.

PROBLEM	POSSIBLE SOLUTION
Display Problems	
No display is visible after pressing the on/off key.	If C cells are used, make certain that they are installed properly with regard to polarity and that good batteries are used. If a rechargeable battery pack is used, place the pack in the instrument and charge for 30 minutes.
Instrument software appears to be locked up as evidenced by no response to keypad entries or display not changing.	First, attempt to reset the instrument by simply turning off and then on again. If this fails, remove battery power from the instrument for 30 seconds and then reapply power. When using C cells, remove the battery lid and one of the batteries; when using the rechargeable battery pack, remove the pack completely from the instrument. After 30 seconds replace the battery or battery pack and check for instrument function.
The 556 display flashes and the instrument speaker makes a continuous clicking sound.	The battery voltage is low. Change to new C cells or recharge the 6117 battery pack.
Water Damage to Instrument	
Leakage detected in battery compartment when using C cells	Dispose of batteries properly. Dry the battery compartment using compressed air if possible. If corrosion is present on battery terminals, contact YSI Customer Service.
Water has contacted rechargeable battery pack	Remove battery pack immediately. Send battery pack to YSI Product Service for evaluation. **CAUTION**: DO NOT REUSE BATTERY PACK UNTIL YSI PRODUCT SERVICE HAS EVALUATED IT.
Leakage suspected into the main cavity of the instrument case	Remove the batteries immediately. Return the instrument to YSI Product Service.

PROBLEM	POSSIBLE SOLUTION
Optional Cigarette Lighter Charger	
Power cord fuse blown  	1. Unscrew adapter's cap, remove tip and pull out fuse. 2. Replace fuse with a new 2-amp fast-blow fuse from an electronics store such as Radio Shack. 3. Reassemble the adapter and securely screw the cap back onto the adapter body.
File Problems	
Upload of files from YSI 556 MPS to PC fails	1. Make sure that cable is connected properly to both 556 and PC. 2. Make certain that the proper Comm port is selected in EcoWatch for Windows.
Barometer data is not stored with sensor data file.	Make sure **Store barometer** is active in the 556 **Logging setup** menu.
Site Descriptions in the **Site List** are "grayed-out" and not available for appending files with additional data.	There is a parameter mismatch between the current 556 setup and that initially used. Change the current logging and sensor setup to match the setup that was initially used to create the file.
Sensor Problems	
Dissolved Oxygen reading unstable or inaccurate. Out of Range message appears during calibration.	Sensor not properly calibrated. Follow DO cal procedures.
	Membrane not properly installed or may be punctured. Replace membrane cap.
	DO sensor electrodes require cleaning. Follow DO cleaning procedure. Use 5511 Maintenance kit.
	Water in sensor connector. Dry connector; reinstall sensor.
	Algae or other contaminant clinging to DO sensor. Rinse DO sensor with clean water.
	Barometric pressure entry is incorrect. Repeat DO cal procedure.
	Calibrated at extreme temperature. Recalibrate at (or near) sample temperature.
	DO sensor has been damaged. Replace sensor.
	Internal failure. Return probe module for service.

PROBLEM	POSSIBLE SOLUTION
Sensor Problems	
pH or ORP readings are unstable or inaccurate. Out of Range message appears during calibration.	Sensor requires cleaning. Follow sensor cleaning procedure.
	Sensor requires calibration. Follow cal procedures.
	pH sensor reference junction has dried out from improper storage. Soak sensor in tap water or buffer until readings become stable.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace sensor.
	Calibration solutions out of spec or contaminated with other solution. Use new calibration solutions.
	ORP fails Zobell check. Take into account temperature dependence of Zobell solution readings.
	Internal failure. Return probe module for service.
Conductivity unstable or inaccurate. Out of Range message appears during calibration.	Conductivity improperly calibrated. Follow calibration procedure.
	Conductivity sensor requires cleaning. Follow cleaning procedure.
	Conductivity sensor damaged. Replace sensor.
	Calibration solution out of spec or contaminated. Use new calibration solution.
	Internal failure. Return probe module for service.
	Calibration solution or sample does not cover entire sensor. Immerse sensor fully.
Temperature, unstable or inaccurate	Water in connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the 5560 sensor.
Installed sensor has no reading	The sensor has been disabled. Enable sensor.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the sensor.
	Report output improperly set up. Set up report output.
	Internal failure. Return probe module for service.

If these guidelines and tips fail to correct your problem or if any other symptoms occur, contact YSI Customer Service for Advice. Refer to *Appendix E Customer Service*.

14. Appendix A YSI 556 MPS Specifications

14.1 Sensor Specifications

Dissolved Oxygen	
Sensor Type	Steady state polarographic
Range: *% air sat'n* *mg/L*	▪ 0 to 500% air saturation ▪ 0 to 50 mg/L
Accuracy: *% air sat'n*	▪ 0 to 200% air saturation: ±2% of the reading or 2% air saturation; whichever is greater ▪ 200 to 500% air saturation: ±6% of the reading
mg/L	▪ 0 to 20 mg/L: ±2% of the reading or 0.2 mg/L; whichever is greater ▪ 20 to 50 mg/L: ±6% of the reading
Resolution: *% air sat'n* *mg/L*	▪ 0.1% air saturation ▪ 0.01 mg/L
Temperature	
Sensor Type:	YSI Precision™ thermistor
Range:	-5 to 45°C
Accuracy:	±0.15°C
Resolution:	0.01°C
Conductivity	
Sensor Type:	4-electrode cell with auto-ranging
Range:	0 to 200 mS/cm
Accuracy:	±0.5% of reading or ±0.001 mS/cm; whichever is greater–4 meter cable ±1.0% of reading or ±0.001 mS/cm; whichever is greater–20 meter cable
Resolution:	0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity	
Sensor Type:	Calculated from conductivity and temperature
Range:	0 to 70 ppt
Accuracy:	±1.0% of reading or 0.1 ppt; whichever is greater
Resolution:	0.01 ppt

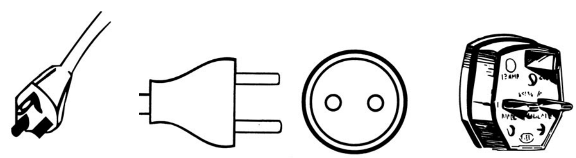
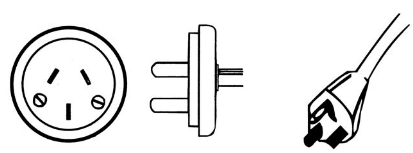
pH (optional)	
Sensor Type:	Glass combination electrode
Range:	0 to 14 units
Accuracy:	±0.2 units
Resolution:	0.01 units
ORP (optional)	
ORP Sensor Type:	Platinum button
Range:	-999 to +999 mV
Accuracy:	±20 mV
Resolution:	0.1 mV

Barometer (optional)	
Range:	500 to 800 mm Hg
Accuracy:	±3 mm Hg within ±15°C temperature range from calibration point
Resolution:	0.1 mm Hg

14.2 Instrument Specifications

Memory Size:	1.5 MB Flash Memory 49,000 data sets (@ 6 parameters per set plus time stamp) 100 Sites
Size:	11.9 cm width x 22.9 cm length (4.7 in. x 9 in.)
Weight with batteries:	0.92 kg (2.1 lbs)
Power:	4 alkaline C-cells; optional rechargeable pack
Cables:	4, 10, and 20 m (13.1, 32.8, 65.6 ft.) lengths
Warranty:	3-Years for the instrument; 1-Year for the probe modules and cable

15. Appendix B Instrument Accessories

ITEM #	ACCESSORY
5563-4	4m Cable with DO/temp/conductivity
5563-10	10m Cable with DO/temp/conductivity
5563-20	20m Cable with DO/temp/conductivity
5564	pH Kit
5565	pH/ORP Kit
6118	Rechargeable Battery Pack Kit for use in US
5094	Rechargeable Battery Pack Kit with universal charger and three adapter cables for use in international applications 
5095	Rechargeable Battery Pack Kit with universal charger and two adapter cables for use in international applications 
5083	Flow Cell – probe module is secured in the flow cell and groundwater is pumped through it
616	Charger, Cigarette Lighter – used to power up the instrument from a car's cigarette lighter
4654	Tripod
614	Ultra Clamp, C Clamp –used to clamp the instrument to a table top or car dashboard
6081	Large Carrying Case, Hard-sided
5085	Hands-free Harness
5065	Carrying Case, Form-fitted, for use in the field – has a clear vinyl window, shoulder strap, belt loop strap and hand strap

16. Appendix C Required Federal Communications Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice.

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No.0004-000-00345-4.

17. Appendix D Health and Safety

YSI Conductivity solutions: 3161, 3163, 3165, 3167, 3168, 3169

INGREDIENTS:

- ❑ Iodine
- ❑ Potassium Chloride
- ❑ Water

WARNING: INHALATION MAY BE FATAL.

⚠ ***CAUTION*: AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY EVOLVE TOXIC FUMES IN FIRE.**

Harmful if ingested or inhaled. Skin or eye contact may cause irritation. Has a corrosive effect on the gastro-intestinal tract, causing abdominal pain, vomiting, and diarrhea. Hyper-sensitivity may cause conjunctivitis, bronchitis, skin rashes etc. Evidence of reproductive effects.

FIRST AID:
INHALATION: Remove victim from exposure area. Keep victim warm and at rest. In severe cases seek medical attention.
SKIN CONTACT: Remove contaminated clothing immediately. Wash affected area thoroughly with large amounts of water. In severe cases seek medical attention.
EYE CONTACT: Wash eyes immediately with large amounts of water, (approx. 10 minutes). Seek medical attention immediately.
INGESTION: Wash out mouth thoroughly with large amounts of water and give plenty of water to drink. Seek medical attention immediately.

YSI pH 4.00, 7.00, and 10.00 Buffer Solutions: 3821, 3822, 3823

pH 4 INGREDIENTS:
- Potassium Hydrogen Phthalate
- Formaldehyde
- Water

pH 7 INGREDIENTS:
- Sodium Phosphate, Dibasic
- Potassium Phosphate, Monobasic
- Water

pH 10 INGREDIENTS:
- Potassium Borate, Tetra
- Potassium Carbonate
- Potassium Hydroxide
- Sodium (di) Ethylenediamine Tetraacetate
- Water

⚠ ***CAUTION*** **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

Inhalation may cause severe irritation and be harmful. Skin contact may cause irritation; prolonged or repeated exposure may cause Dermatitis. Eye contact may cause irritation or conjunctivitis. Ingestion may cause nausea, vomiting and diarrhea.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

YSI Zobell Solution: 3682

INGREDIENTS:

- ❑ Potassium Chloride
- ❑ Potassium Ferrocyanide Trihydrate
- ❑ Potassium Ferricyanide

⚠ ***CAUTION* - AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

May be harmful by inhalation, ingestion, or skin absorption. Causes eye and skin irritation. Material is irritating to mucous membranes and upper respiratory tract. The chemical, physical, and toxicological properties have not been thoroughly investigated.

Ingestion of large quantities can cause weakness, gastrointestinal irritation and circulatory disturbances.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

18. Appendix E Customer Service

For information on Authorized Service Centers, refer to *Authorized Service Centers* in this appendix.

Equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected before being returned or presented for service. A cleaning certificate must accompany the equipment. Refer to *18.2 Cleaning Instructions* in this appendix.

18.1 YSI Environmental Authorized Service Centers

For information on the nearest authorized service center, please contact:

YSI Technical Support • 1725 Brannum Lane
Yellow Springs, Ohio • 45387 • Phone: +1 (937) 767-7241
Phone: 800-897-4151 (US) • Email: environmental@ysi.com

or visit our website for the most current information:

www.ysi.com

18.2 Cleaning Instructions

Equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected before being serviced. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at a YSI Service Center, the following steps must be taken to ensure the safety of service personnel.

- In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4-cup bleach to 1-gallon tap water is suitable for most disinfecting. Instruments used with wastewater may be disinfected with .5% Lysol if this is more convenient to the user.
- The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
- If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
- Any product being returned to the YSI Repair Center should be packed securely to prevent damage.
- Cleaning must be completed and certified on any product before returning it to YSI.

18.3 Packing Procedure

- Clean and decontaminate items to ensure the safety of the handler.
- Complete and include the Cleaning Certificate.
- Place the product in a plastic bag to keep out dirt and packing material.
- Use a large carton, preferably the original, and surround the product completely with packing material.
- Insure for the replacement value of the product.

18.4 Cleaning Certificate

Organization ___________________________________

Department ____________________________________

Address _______________________________________

City ________________ State __ Zip _________________

Country ____________________ Phone ______________

Model No. of Device __ Lot Number _________________

Contaminant (if known) __________________________

Cleaning Agent(s) used __________________________

Radioactive Decontamination Certified?

(Answer only if there has been radioactive exposure)

_______ Yes _______ No

Cleaning Certified By ____________________________

Name Date

18.5 Warranty

The instrument is warranted for three years against defects in workmanship and materials when used for its intended purposes and maintained according to instructions. The probe module and cables are warranted for one year. The dissolved oxygen, temperature/conductivity, pH, and pH/ORP combination sensors are warranted for one year. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI'S LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

19. Appendix F Ferrite Bead Installation

⚠ **WARNING:** If you are using your YSI 556 in a European Community (CE) country or in Australia or New Zealand, you must attach a ferrite bead to the 655173 PC Interface Cable and the YSI 6117 Charger Adapter Cable in order to comply with the Residential, Commercial and Light Industrial Class B Limits for radio-frequency emissions specified in EN55011 (CISPR11) for Industrial, Scientific and Medical laboratory equipment. These ferrite assemblies are supplied as part of cable kits.

1. Make a small loop (approximately 5 cm in diameter) in the cable near the YSI 556 MS-19 connector.

2. Lay the open ferrite bead assembly under the loop with the cable cross-over position within the cylinder of the ferrite bead.

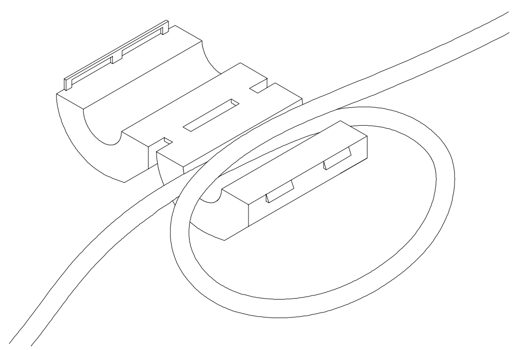


Figure 19.1 Ferrite Bead Installation

3. Snap the two pieces of the bead together making certain that the tabs lock securely.

4. When the installation is complete, the 655173 and YSI 6117 cables should resemble the following drawings.

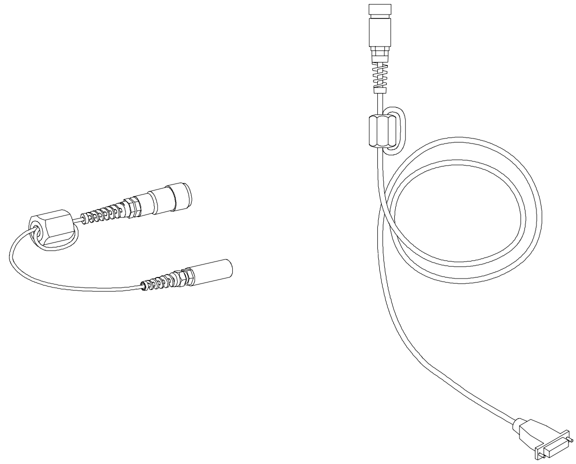


Figure 19.2 Cables with Ferrite Beads

20. Appendix G EcoWatch

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. EcoWatch is a powerful tool that can also be used with YSI 6-series sondes. Many features of the software will only be utilized by advanced users or are not relevant to the 556 MPS at all. This section is designed in tutorial format to familiarize you with the commonly used features of EcoWatch so that it will be possible to:

- Upload data from a 556 MPS to a PC
- Assemble plots and reports of your data
- Zoom in on certain segments of the plots of your data to facilitate analysis
- Show statistical data for your studies
- Export data in spreadsheet-compatible formats
- Print plots and reports

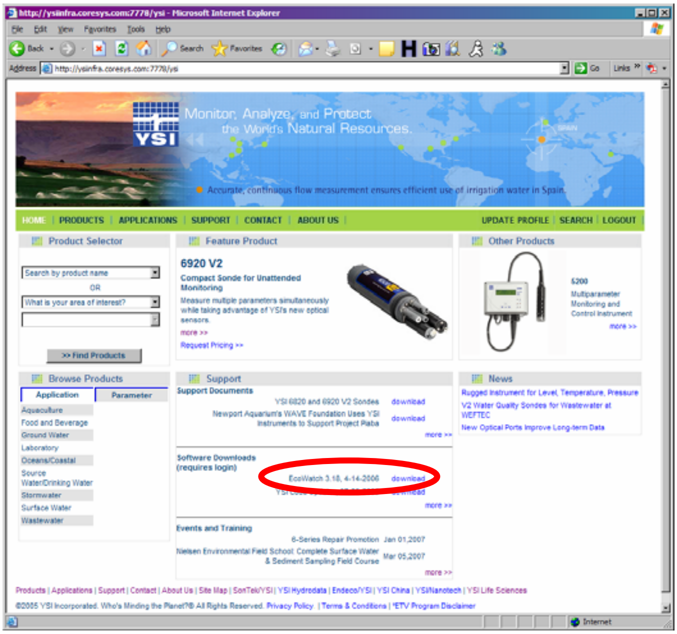
The advanced features of EcoWatch can be explored by downloading a 6-series manual from the YSI Web Site (www.ysi.com), purchasing a hard copy of the manual through YSI Customer Service (Item # 069300), or utilizing the on-line help feature of the software.

20.1 Installing EcoWatch for Windows

EcoWatch for Windows is available at no cost via a download from the YSI Web Site.

1. Access the YSI Web Site at www.ysi.com.

2. Click on the **Login** link and login (or register if you have not previously registered).



3. Click on the EcoWatch link and save the file to a directory on your computer.

4. After the download is complete, run the EcoWatch file (that you just downloaded) and follow the on screen instructions to install the software on your computer.

If you encounter difficulties in the download procedure, contact YSI Customer Service. Refer to ***Appendix E Customer Service***. Alternatively, you may purchase the software on CD ROM (Item #006075) by contacting YSI Customer Service.

20.2 EcoWatch Tutorial

This EcoWatch tutorial is designed to teach you the commonly used operations associated with the software when used with your 556 MPS.

After you have uploaded a file, Refer to Section 8.4 Upload to PC, you will see two files in the C:\ECOWWIN\DATA directory; the file you transferred and a file supplied by YSI designated SAMPLE.DAT. This SAMPLE.DAT file is referred to in the remainder of this tutorial section. After following the instructions below for the analysis of SAMPLE.DAT, you apply the same analysis to the data file which was uploaded from your 556 MPS to assure that you are familiar with the basic features and capabilities of EcoWatch for Windows.

To start the analysis of the SAMPLE.DAT file, note that a shortened menu bar is visible and many of the tools in the toolbar appear dimmed or "grayed out" before any file is opened (see below).

Full activation of EcoWatch features will be realized after a file is opened.

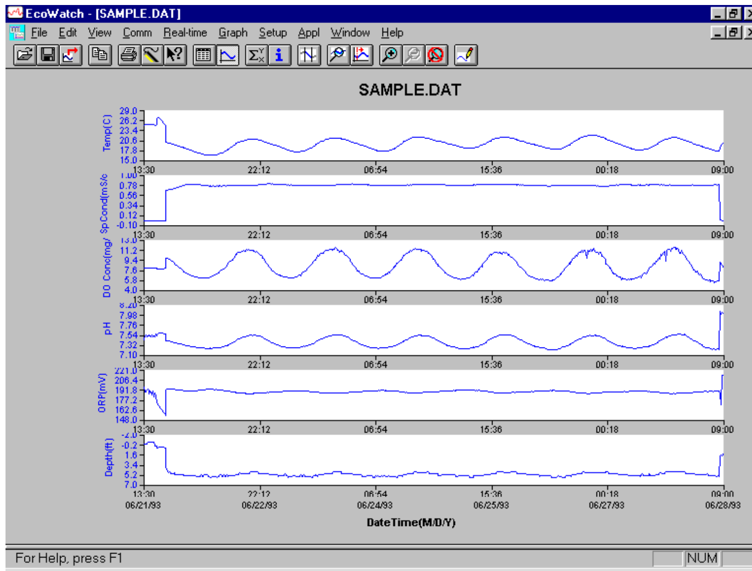
To open the sample data file:

5. 1. Click the **File** menu  button in the toolbar.

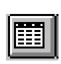
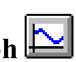
6. 2. Select the **SAMPLE.DAT** file.

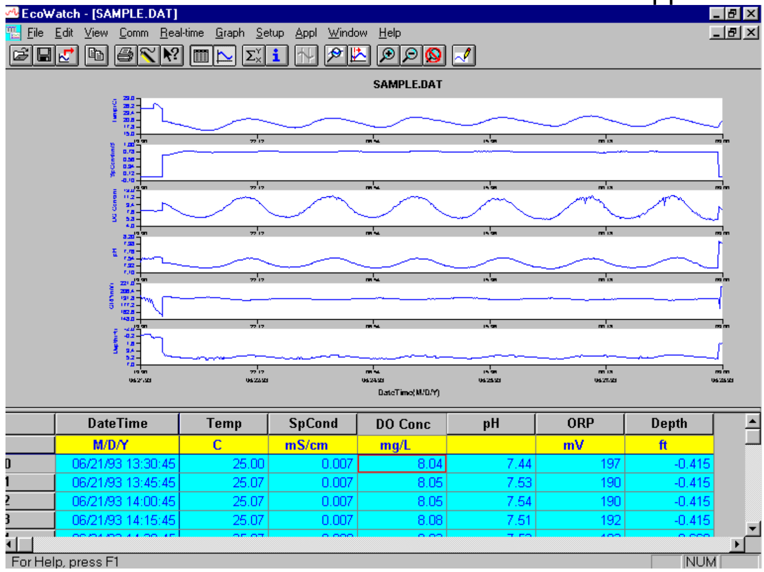
7. 3. Click **OK** to open the file.

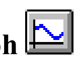
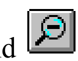
The following display will appear:

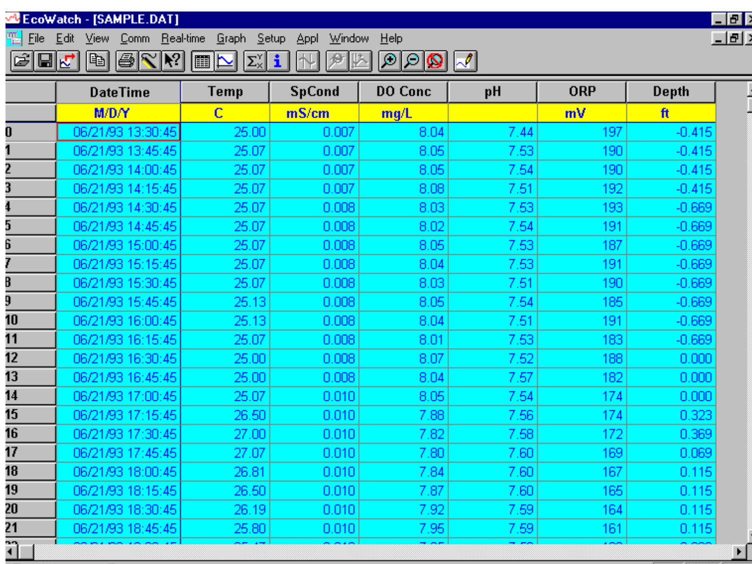


Note that the data in this file appears as a graph of temperature, specific conductance, dissolved oxygen, pH, ORP, and depth, all versus time. The graphs are scaled automatically so that all data fits comfortably on the computer screen. Note also that this data file was obtained with a 6-series sonde for which a depth sensor is available. Depth is NOT a current parameter for the 556 MPS.

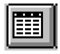
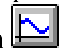
The **Table**  and **Graph**  buttons on the toolbar are on/off switches that are used to display or hide the graph and table pages respectively. When displaying a graph and a table at the same time, you can control the relative size of the two pages by placing the cursor over the small bar that separates them and then dragging it to the desired location. Click the **Table**  button to generate the following dual display of data.

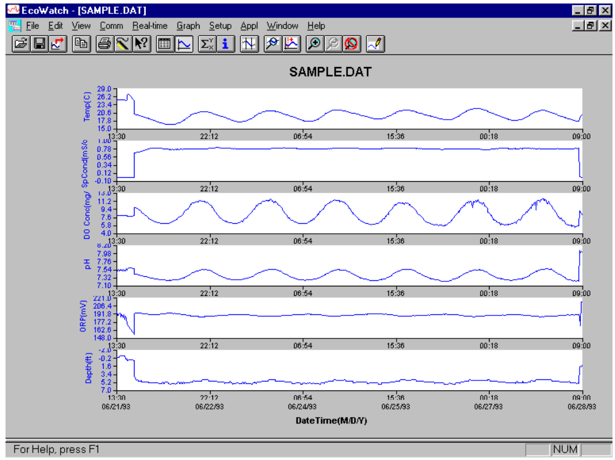


Now click the **Graph**  button (turn it off) to display only a report of your data as shown below. Note that the size of the report can be varied by clicking on the  and  buttons in the Toolbar.

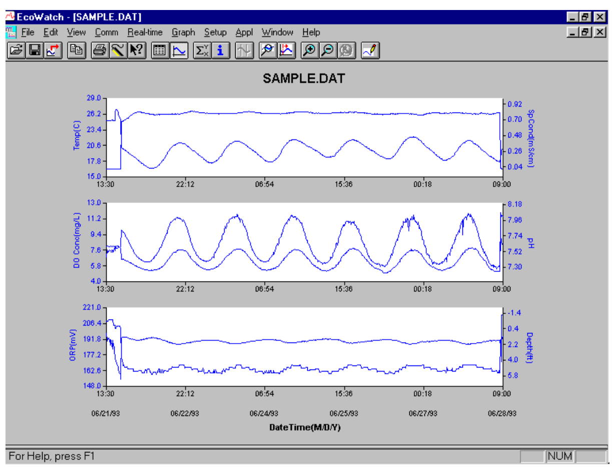


	DateTime	Temp	SpCond	DO Conc	pH	ORP	Depth
	M/D/Y	C	mS/cm	mg/L		mV	ft
0	06/21/93 13:30:45	25.00	0.007	8.04	7.44	197	-0.415
1	06/21/93 13:45:45	25.07	0.007	8.05	7.53	190	-0.415
2	06/21/93 14:00:45	25.07	0.007	8.05	7.54	190	-0.415
3	06/21/93 14:15:45	25.07	0.007	8.08	7.51	192	-0.415
4	06/21/93 14:30:45	25.07	0.008	8.03	7.53	193	-0.669
5	06/21/93 14:45:45	25.07	0.008	8.02	7.54	191	-0.669
6	06/21/93 15:00:45	25.07	0.008	8.05	7.53	187	-0.669
7	06/21/93 15:15:45	25.07	0.008	8.04	7.53	191	-0.669
8	06/21/93 15:30:45	25.07	0.008	8.03	7.51	190	-0.669
9	06/21/93 15:45:45	25.13	0.008	8.05	7.54	185	-0.669
10	06/21/93 16:00:45	25.13	0.008	8.04	7.51	191	-0.669
11	06/21/93 16:15:45	25.07	0.008	8.01	7.53	183	-0.669
12	06/21/93 16:30:45	25.00	0.008	8.07	7.52	188	0.000
13	06/21/93 16:45:45	25.00	0.008	8.04	7.57	182	0.000
14	06/21/93 17:00:45	25.07	0.010	8.05	7.54	174	0.000
15	06/21/93 17:15:45	26.50	0.010	7.88	7.56	174	0.323
16	06/21/93 17:30:45	27.00	0.010	7.82	7.58	172	0.369
17	06/21/93 17:45:45	27.07	0.010	7.80	7.60	169	0.069
18	06/21/93 18:00:45	26.81	0.010	7.84	7.60	167	0.115
19	06/21/93 18:15:45	26.50	0.010	7.87	7.60	165	0.115
20	06/21/93 18:30:45	26.19	0.010	7.92	7.59	164	0.115
21	06/21/93 18:45:45	25.80	0.010	7.95	7.59	161	0.115

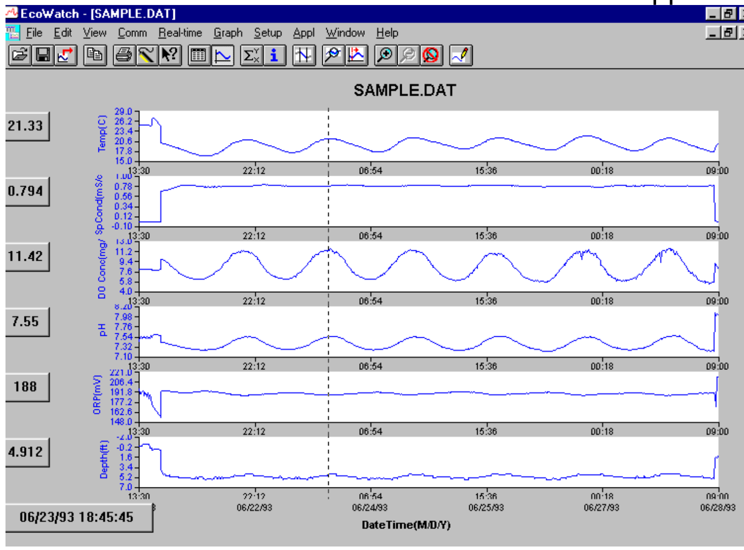
Now return to the original graphic display by toggling the **Table**  button "off" and **Graph**  button "on".



From the **Setup** menu, click **Graph**. Click **2 Traces per Graph** and notice that the parameters are now graphed in pairs for easy comparison of parameters.

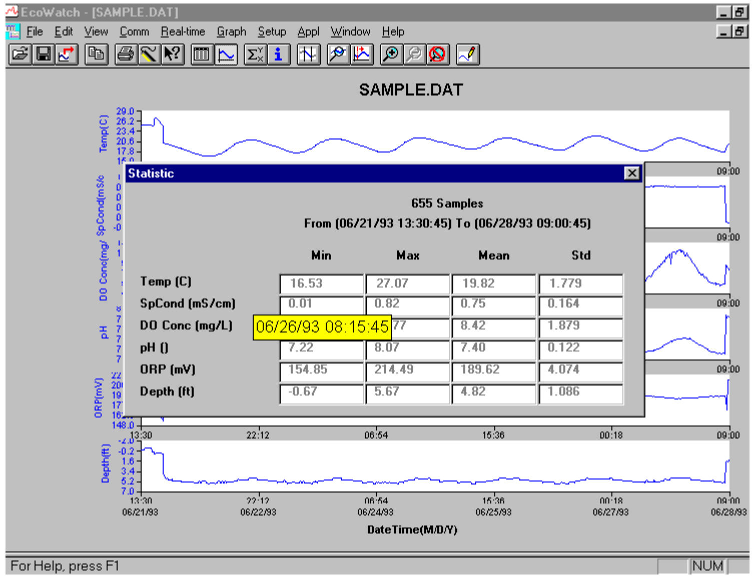


Click **1 Trace per Graph** to return the display to the original setting. Move the cursor to any position in the graph, then click and hold the right mouse button.

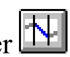


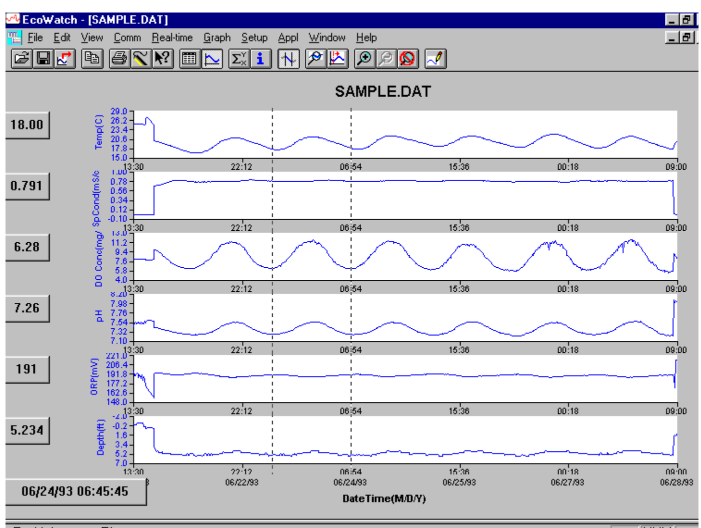
Note that the exact measurements for this point in time are displayed to the left of the graph. While holding down the right mouse button, move to another area on the graph. Notice how the measurements change as you move. When you release the mouse button, the display returns to normal.

To view statistical information for the study, click the **Statistics**  button on the toolbar. On the statistics window, click on any min or max value to display the time when it occurred.

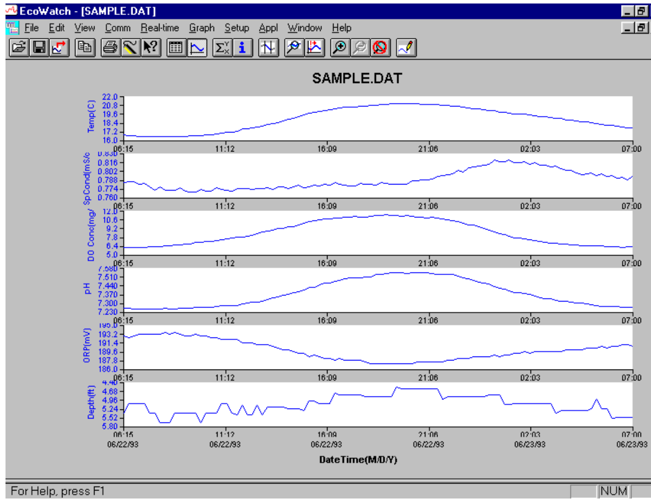


After viewing statistics, click the "x" at the upper right to close the window and return to the normal display.

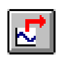
Now click on the delimiter  icon in the toolbar and then move the displayed icon to the graph. Click at the two points shown by dotted lines in the display below, being sure that the first click is to the left of the second.

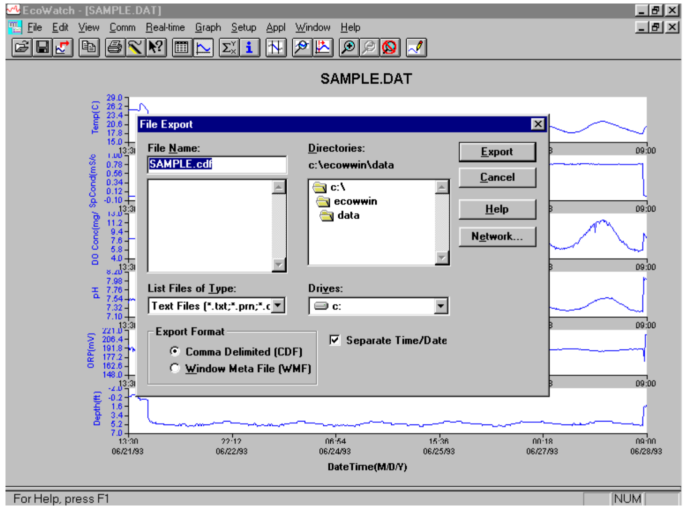


The data between the two selected points will then be graphed in higher resolution as shown below.

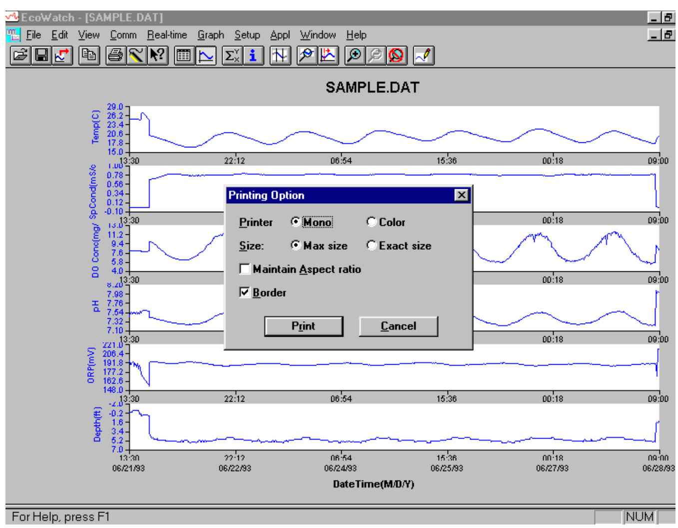


To return to the complete data set, select **Graph** from the toolbar and then click **Cancel Limits**.

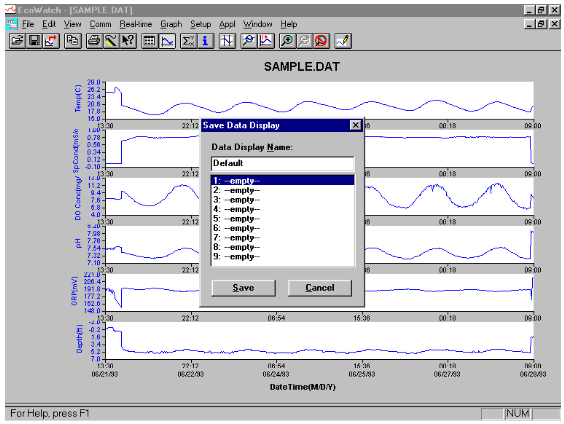
Now select the  icon from the Toolbar to create a new data file which will allow your data to be imported into spreadsheets. Select the default export settings for a Comma Delimited File (.CDF) and click OK. A new spreadsheet-importable file (SAMPLE.CDF) is now present in the same folder as the SAMPLE.DAT file.



Now select the  icon from the toolbar to print the plot. Accept the default settings and click OK to complete the printing operation.



Finally, end the tutorial by saving the **Data Display** in the format shown. From the **File** menu, click **Save Data Display**.

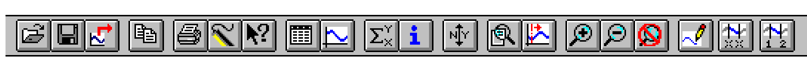


Then type “Default” for the file name and click **Save**. The parameters, colors, format, and x-axis time interval associated with the current display are now saved and can be accessed any time in the future. Nine different data displays may be saved for any data file. You can easily switch between various displays of the data. The data files can be accessed by clicking **Load Data Display** from the file menu and then selecting the desired presentation.

20.2.1 Summary of Toolbar Capability

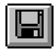
The EcoWatch toolbar includes buttons for some of the most common commands in EcoWatch, such as **File Open**. To display or hide the toolbar, open the **View** menu and click on the **Toolbar** command. A check mark appears next to the menu item when the toolbar is displayed.

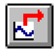
The toolbar is displayed across the top of the application window, below the menu bar.



Click To:

Open an existing data file (.DAT). EcoWatch displays the **Open** dialog box, in which you can locate and open the desired file.

 Save the working Data Display of the active data file. EcoWatch displays the **Save Data Display** dialog box in which you can overwrite existing Data Display or save to a new one.

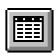
 Export data as a graph in Window Meta File (.WMF) format or as data in Comma Delimited (.CDF) format.

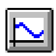
 Copy the whole graph page or data from the selection on the table to the clipboard.

 Print the active graph page or table page depending on which one is currently active.

 Open a new terminal window to communicate with the sonde.

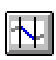
 Access context sensitive help (Shift+F1).

 Toggle table window during file processing.

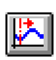
 Toggle graph window during file processing.

 Display study statistics.

 Display study info.

 Limit the data to be processed in a study.

 Enlarge a selective portion of graph.

 Center the graph under the cursor.

 Enlarge graph or table 20%.

 Reduce graph or table 20%.

 Return graph or table to its normal state (unzoom)

 Redraw the graph.

20.2.2 Other Capabilities

The above tutorial and function list for the toolbar provide basic information to allow you to view and analyze the field data which was stored in your 556 MPS. Some of the other commonly used capabilities of EcoWatch which the user may want to explore are listed below:

- Customize the units for each parameter, e.g., report uS/cm instead of mS/cm for conductivity.
- Customize the order of parameters in each plot or report.
- Customize the colors and fonts of each data display.
- Manually scale the y-axis sensitivity for each parameter.
- Merging of two or more data files with compatible parameter formats
- View information about the study such as number of points, instrument serial number, etc. which was stored in the 556 with the data.
- Print data reports in different statistical formats.
- Create plots of parameter vs. parameter rather than parameter vs. time.

These additional features of EcoWatch for Windows are explained in detail in the YSI 6-series manual (which can be downloaded at no cost from the YSI Web Site as described above) and the Help selection in the EcoWatch menubar. To purchase a hard copy of the 6-series manual, contact YSI Customer Service using the contact information in *Appendix E Customer Service*.

21. Appendix H Calibration Record Information

When your YSI 556 MPS sensors are initially calibrated, relevant information about the sensors will be stored in a separate file in the YSI 556 MPS memory.

NOTE: This file, by default, will have the name "556 Circuit Board Serial Number.glp." The circuit board serial number is assigned at the factory and has a hexadecimal format such as 000080A4. Thus the default calibration record file would be designated 00080A4.glp. Refer to Section *10.7 GLP Filename* to change the filename.

The information in the calibration record will track the sensor performance of your instrument and should be particularly useful for programs operating under Good Laboratory Practices (GLP) protocols.

21.1 Viewing the Calibration Record (.glp) File

NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

1. Follow the procedures outlined in Section *8.3 View File*.

21.2 Uploading the Calibration Record (.glp) File

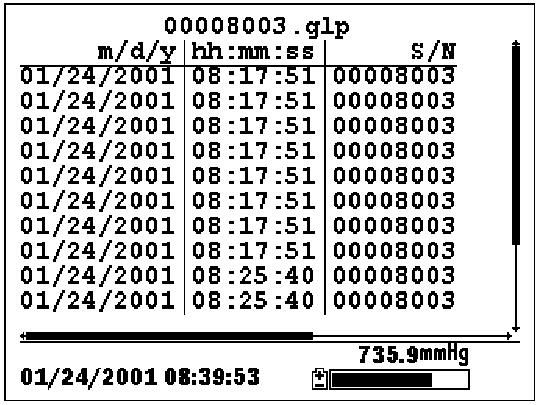
NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

1. Follow the procedures outlined in Section *8.4 Upload to PC*.

21.3 Understanding the Calibration Record (.glp) File

1. Open a calibration record file. Refer to Section *8.3 View File*.

2. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

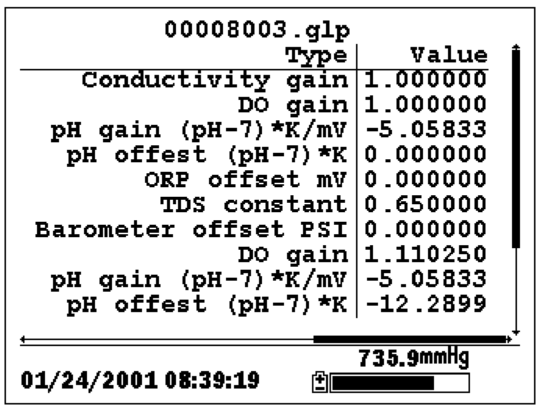


00008003.glp

m/d/y	hh:mm:ss	S/N
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:25:40	00008003
01/24/2001	08:25:40	00008003

735.9mmHg
01/24/2001 08:39:53

Figure 21.1 Calibration Record Screen 1



00008003.glp

Type	Value
Conductivity gain	1.000000
DO gain	1.000000
pH gain (pH-7)*K/mV	-5.05833
pH offest (pH-7)*K	0.000000
ORP offset mV	0.000000
TDS constant	0.650000
Barometer offset PSI	0.000000
DO gain	1.110250
pH gain (pH-7)*K/mV	-5.05833
pH offest (pH-7)*K	-12.2899

735.9mmHg
01/24/2001 08:39:19

Figure 21.2 Calibration Record Screen 2

NOTE: Each sensor (not parameter) is characterized by either 1 line (Conductivity, Dissolved Oxygen, ORP, TDS, or Barometer (Optional)) or 2 lines (pH) of calibration documentation.

The left hand portion of each calibration entry shows the date and time that a calibration of a particular sensor was performed. In addition, each calibration entry is characterized by the instrument serial number, as defined by YSI. See Figure 21.1 Calibration Record Screen 1. The right hand portion shows the YSI designation of the calibration constants and their values after their calibration has been performed. A more detailed description of the calibration constants is provided below:

- **Conductivity Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the calculated cell constant divided by the typical value of the cell constant (5 cm^{-1}).

- **DO Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the sensor current at the time of calibration divided by the typical value of the sensor current (15 uA).

- **pH Gain** – A number which basically represents the sensitivity of the pH sensor. To remove the effect of temperature on the slope of the relationship of probe output in mv versus pH, the value of pH/mv is multiplied by the temperature in degrees Kelvin (K).

- **pH Offset** – A number which basically represents the offset (or intercept) of the relationship of probe output in mv versus pH, the value of pH is multiplied by the temperature in degrees Kelvin (K).

Anytime you perform a calibration, information concerning the calibration constants will be logged to the Calibration Record file (.glp file). However, if the **Delete All Files** command is used, Refer to Section *8.6 Delete All Files*, the Calibration Record file will also be lost. It is critical that this file should be uploaded to your PC prior to issuing a **Delete All Files** command. Refer to Section *8.4 Upload to PC*.

Y S I *i n c o r p o r a t e d*

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A655279C
655279Web
January 2004

Standard Operating Procedure F-12
Ambient Air Monitoring for Fugitive Dust

This standard operating procedure (SOP) is applicable to fugitive dust monitoring. The methodology is generic in nature and may be modified in whole or in part to meet the constraints presented by site conditions and equipment limitations. Modifications of monitoring methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and monitoring results.

Equipment

Equipment needed for fugitive dust monitoring may include the following:

- Miniram monitor or equivalent
- Personal attachment pump (if performing active air sampling)
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

Airborne particles will be measured using an MIE, Inc., Miniram monitor or equivalent. This is a hand-held field instrument that measures dust concentrations in the range of 0.001 to 400 milligrams/cubic meter (mg/m^3). The Miniram monitor displays the 10-second averaged concentration, as well as the real-time concentration, on a direct-read liquid-crystal display.

Operational Procedures

General Information

On each day that fugitive dust monitoring is being performed, record the following general information:

- Date
- Time
- Location
- Weather conditions
- Names of personnel performing the monitoring
- Visual observations
- Problems and corrective actions taken

- Maintenance performed
- Monitoring results
- Miniram calibrations
- Concerns or complaints from the public

Meter Calibration

Prior to initiating fugitive dust monitoring, calibrate the Miniram monitor in accordance with the manufacturer's recommended procedures.

Data Collection

- Before initiating data collection, zero the Miniram monitor in a particle-free area, in accordance with the manufacturer's recommended procedures.
- Conduct passive or active air sampling, as follows:
  - **Passive Air Sampling** – The collection of passive air samples involves allowing ambient air to freely access the sensing chamber of the instrument by means of convection, diffusion, and adventitious air motion. No additional equipment (i.e., pump) needs to be connected to the Miniram monitor.
  - **Active Air Sampling** – The collection of active air samples involves connection of a personal attachment pump to the Miniram monitor. The pump flow rate is set at 2 L/min for standard applications, but can be adjusted according to the anticipated particle size.
- Record the following measurements: run start time and date, time-averaged concentration, elapsed run time, maximum and short-term exposure limits (STEL) with times of occurrence, and end run time.
- Download the data from the Miniram monitor to a computer.

Maintenance Procedures

The Miniram monitor will be maintained according to the manufacturer's instructions. A replacement meter and/or gauges will be ready for overnight shipment, if needed.

Standard Operating Procedure F-13
Ambient Air Monitoring for VOCs

This standard operating procedure (SOP) is applicable to ambient volatile organic compound (VOC) monitoring. The methodology is generic in nature and may be modified in whole or in part to meet the constraints presented by site conditions and equipment limitations. Modifications of monitoring methodologies will be documented in the appropriate field logbook and discussed in reports summarizing field activities and monitoring results.

Equipment

Equipment needed for ambient VOC monitoring may include the following:

- Photoionization detector (PID)
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

Organic vapors will be measured using a PID, or equivalent. This is a hand-held field instrument that measures the concentration of organic vapors in the range of 0.1 to 1,000 ppm.

Operational Procedures

General Information

On each day that ambient VOC monitoring is being performed, record the following general information:

- Date
- Time
- Location
- Weather conditions
- Names of personnel performing the monitoring
- Visual observations
- Problems and corrective actions taken

- Maintenance performed
- Monitoring results
- PID calibrations

Meter Calibration

Prior to initiating ambient VOC monitoring, the PID will be calibrated in accordance with the manufacturer's recommended procedures. In addition, the PID will be recalibrated in accordance with the operating procedures.

Data Collection

- Power the PID on. The liquid crystal display (LCD) displays the real-time organic vapor concentration while the PID is running.
- Wait for the concentration to stabilize before recording a value.

Maintenance Procedures

The PID will be maintained according to the manufacturer's instructions. A replacement meter and/or gauges will be ready for overnight shipment, if needed.

Standard Operating Procedure F-14
Real-Time Turbidity Measurement Procedures for Surface Water

This standard operating procedure (SOP) sets forth the field procedures for the collection of surface water samples from shore for the measurement of turbidity.

Equipment

Equipment needed for turbidity monitoring may include the following:

- Hand-held turbidity meter
- Polyethylene scoop with an extended handle
- Site plan
- Logbook
- Field data sheets
- Safety equipment

Targeted Compounds and Measurements

Turbidity will be measured using a hand-held turbidity meter.

Operational Procedures

General Information

On each day that turbidity monitoring is being performed, record the following general information:

- Date
- Time
- Location
- Weather conditions
- Names of personnel performing the monitoring
- Visual observations
- Problems and corrective actions taken
- Maintenance performed
- Monitoring results
- Turbidity meter calibrations
- Concerns or complaints from the public

Meter Calibration

Prior to initiating turbidity monitoring, calibrate the turbidity meter in accordance with the manufacturer's recommended procedures.

Surface Water Sampling Procedures

Surface water samples will be collected using a polyethylene scoop with an extended handle and analyzed using a hand-held turbidity meter. Prior to initiating field activities, the turbidity meter will be calibrated according to the manufacturer's instructions, and the calibration data will be recorded in the logbook or on the Water Quality Meter Calibration Log. The procedures for collection of the surface water samples are provided below.

1. Record the sample location on the sample log or in field notebook, along with other appropriate information (include a sketch indicating location relative to shore features, if appropriate).
2. Don health and safety equipment (as required by the Multi-Area HSP).
3. Lower the scoop into the water, and raise it from the water column with minimal disturbance.
4. Measure the turbidity of the sample, and record it in a logbook or on a Surface Water Sampling Log.

Maintenance Procedures

The turbidity meter will be maintained according to the manufacturer's instructions. A replacement meter will be ready for overnight shipment, if needed.

Standard Operating Procedure F-15
Monitoring Well Installation Procedures

This standard operating procedure (SOP) sets forth the procedures for the installation of monitoring wells for the purpose of groundwater monitoring. The following procedures are generic in nature and can be modified as required by site specific conditions.

Design of Groundwater Monitoring Network

A groundwater monitoring well network is typically identified prior to field work.

The groundwater monitoring network is designed to detect potential impacts from the site and should be constructed so that the wells are suitable for data collection activities. The water table is also identified via water level data collected from monitoring wells and can be used to identify locations for new groundwater monitoring wells.

Monitoring wells will be used to aid in the interpretation of the groundwater flow direction. The deep monitoring wells are installed to establish the vertical gradient at the site. The top of the screen of the deep monitoring wells will be installed 20 feet below the bottom of the shallow monitoring well or to the base of the upper groundwater flow system, whichever is shallower. All of the wells will be placed along areas of easy access to facilitate sampling and outside the limits of waste to minimize the potential of dragging down impacts during well installation.

Equipment/Apparatus

Equipment needed for installation of monitoring wells may include:

- Maps/plot plan
- GPS
- Safety equipment
- Tape measure
- Survey stakes, flags,
- Camera
- Logbook
- Drill Rig
- GeoProbe®
- Nephelometer
- PVC
- Johnson Vee-wire® screens

- bentonite
- Artificial sand packs

Installation of Monitoring Points

Soil Boring Methods

A boring will be installed with 6.25-inch–inner-diameter hollow-stem augers. Split-spoon sampling will be performed at continuous intervals through the hollow-stem augers as the borings are advanced in general accordance with ASTM Method 1586. Soil samples will be described using the Unified Soil Classification System.

Split-spoon samplers will be driven using a 140-pound hammer with a 30-inch drop. Unless necessary to control heaving of sand within the augers, drilling fluids will not be used.

The borings will be advanced to the target depth for each well, which will be determined by vertical aquifer sampling.

Monitoring Well Construction

The monitoring wells are designed to provide representative groundwater samples from the aquifer.

The wells will be built using NSF-approved, wire-wrapped, 2-inch–diameter, Schedule 40 PVC riser and screen. Johnson Vee-wire® screens, or equivalent, will be used to construct the wells. (PVC has been selected as the material of choice for construction of the monitoring wells because it has been shown to be non-reactive with inorganic compounds, including metals as well as organic compounds.) If initial data rounds suggest a concern regarding VOC concentrations and PVC interference, stainless steel wells will be considered, with similar installation techniques. The screen slot size will be determined on the basis of visual characterization of the formation material at each location. Typically, 0.010-inch slots will be used unless a significant thickness of coarse materials is encountered. If a significant thickness of coarse materials is encountered at a well location, then 0.020-inch slot screens will be used. For a 0.010-inch slot screen, a No. 20-40 mesh sand pack will be used; for a 0.020-inch slot screen, a No. 10-20 mesh sand pack will be used, in accordance with ASTM Method D-5092-90. The sand pack material will be installed from the base of the well screen to 1 to 2 feet above the top of the well screen, unless space prohibits.

Water table monitoring wells will be constructed using a 7-foot screen, which will be placed to straddle the water table. Where a well nest is proposed, the deep monitoring wells will be constructed with a 5-foot screen, the top of which will be located no less than 20 feet below the bottom of the shallow monitoring well unless otherwise determined based upon vertical aquifer sampling results.

At a minimum, 2 feet of bentonite seal (chips or pellets) will be placed above the top of the sand pack. If the seal is above the water table, the bentonite will be hydrated and the remaining annulus will then be tremie grouted from the bentonite seal to the surface with a cement-bentonite grout. The volume of water used in hydrating the bentonite will be recorded on the well construction diagram.

Each monitoring well will be furnished with watertight expansion plugs. The wells will be finished with a locking protective surface casing, and will extend 2 to 3 feet above final grade.

Elevation of Well Screens

Unless otherwise described in the applicable work plan, the screen will be located so that samples are collected from the zone that is representative of the highest concentrations of potential site constituents present in the groundwater, in accordance with R 299.5716. In order to screen the monitoring wells in the zone of potentially highest impact, vertical aquifer sampling will be performed at each of the groundwater monitoring locations. Vertical profiling will be performed at 10-foot intervals from the water table to a depth of 40 feet below the water table. This sampling interval is appropriate for sites with thick homogeneous aquifers and relatively simple geology and where the plume is expected to be thick and diffuse in accordance with the May 6, 1994, MDEQ "position paper" on vertical aquifer sampling (VAS). The thick alluvial sand deposit underlying the landfill qualifies as "thick and homogeneous" and relatively simple, while a landfill would be expected to produce a plume that would be "thick and diffuse."

The vertical aquifer sampling will be performed prior to monitoring well installation using a GeoProbe® or equivalent groundwater sampler. The GeoProbe sampler will be advanced to the target vertical depth and then opened. After purging at least one liter, a sample will be collected using the same low-flow sample collection methods described in SOP-F8. Samples will be analyzed in the field for pH, ORP, dissolved oxygen, specific conductance, and temperature. Samples will be collected and sent to a laboratory for analysis of ammonia, chloride, sulfate, and total dissolved solids.

The results of the field sampling and the laboratory analysis will be used to identify the zone that is representative of the highest concentrations of potential site constituents present in the groundwater. If there is no clear zone that indicates potentially higher impacts, the monitoring well will be completed as a shallow water-table monitoring well.

If the monitoring wells are to be constructed at the water table, care will be taken to set the top of the screened interval of the well at as high an elevation as feasible, so that the top of the screen is above the water table as much as possible and the length of saturated well screen is close to five feet.

The surface seal will consist of 2 feet of bentonite, with a sand pack above the top of the screen to prevent the bentonite surface seal from migrating into the top of the well screen. A 1-foot–thick sand pack will be constructed above the top of the well screen in each well unless space prohibits. At a minimum, a 0.5-foot–thick sand pack will be installed in each well.

Well Development

The wells will be developed to ensure that the wells have a good hydraulic connection with the shallow aquifer. Well development will commence no sooner than 24 hours after well construction unless modified by the USEPA project manager based upon field conditions.

The wells will be developed by surging and purging with a surge block and submersible pump system. Well development will be performed until the water discharged from the wells is free of sediment, if possible. The turbidity, pH, temperature, specific conductance, and ORP of the development water will be periodically monitored to evaluate stabilization. If the quality of the development water is not stabilizing at an appreciable rate after 4 hours, then well development may be ceased at that time. Well development can cease when three times the volume of water injected into the well during drilling and/or construction have been removed from the well and:

i. field parameters (pH, temperature, etc.) have stabilized for three consecutive well volumes (readings may only start after removing three times the volume of water injected into the well have been removed from the well), or
ii. an additional 20 well volumes have been purged.

If the well yields insufficient water to sustain pumping, it should be developed using a bailer and development should continue until three times the volume of water injected into the well during drilling and/or construction have been removed from the well and an additional 15 well volumes have been removed.

References

ASTM Method D-5092-90. American Society for Testing and Materials (ASTM), Standard D 5092-90, Standard Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers

R 299.5716. RRD Operational Memorandum No. 5, Groundwater Surface Water Criteria, Michigan Department of Environmental Quality, Remediation and Redevelopment Division, September 30, 2004.

Attachment B
Example Forms/Logs

RMT

	LOCATION I.D.	
	JOB NO.	
	PROJECT	
	CLIENT	
	ELEVATION	
DRILLER:	STARTED	
INSPECTOR:	FINISHED	
	GROUNDWATER	

TYPE	SAMP	COR	CASE			
DIA.						
WT						
FALL						

Well Construction	FT.	NO.	Type	Rec.	BLOWS per 6 in			CLASSIFICATION	REMARKS
	2								
	4								
	6								
	8								
	10								
	12								
	14								
	16								
	18								
	20								

RMT

DATE________
DWN_________
APP__________
REV__________
PROJECT NO.
00-05133.03

Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
OU-4 Emergency Action at the 12th Street Landfill Former Powerhouse Discharge Channel

TEST BORING RECORD

G:\DATA\HYDRO\DM\TESTBORINGRECORDTEMPATE.XLS

RMT

FIELD SAMPLING FORM

Job Name: ____________________

Job Number: __________________ Sample ID: ______________ Date: ___________

Media Sampled:	Soil ________	Groundwater ________	Sludge ________	Other ________

SAMPLE INFORMATION			
Container		Sample Collected By: ___________________________________	
Type	Volume	Preservative	Comments

Depth to Water (feet) = ________ Total Depth (feet) = ________ Purge Volume (gallons) = ________

FIELD PARAMETERS		Volume Purged (gallons): ______________________________	
Parameter	Equipment	Results	Comments

General Comments (sample appearance, odor, etc):

Samples shipped to: ____

Via: FEDEX________ Delivery________ UPS________ Other________

Weather: ____

RMT

DATE________
DWN________
APP________
REV________
PROJECT NO.
00-05133.03

Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
OU-4 Emergency Action at the 12th Street Landfill Former Powerhouse Discharge Channel

FIELD SAMPLING FORM

RMT

WATER LEVEL DATA FORM

Job Name: ________________
Job Number: ________________ Date: _____________ Page ____ of ____

WELL ID	TIME	DEPTH TO WATER (feet below TOC)	TOTAL DEPTH (feet below TOC)	PURGE VOLUME (gallons)

RMT

DATE ______
DWN_______
APP ________
REV ________

PROJECT NO.
00-05133.03

Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
OU-4 Emergency Action at the 12th Street Landfill
Former Powerhouse Discharge Channel

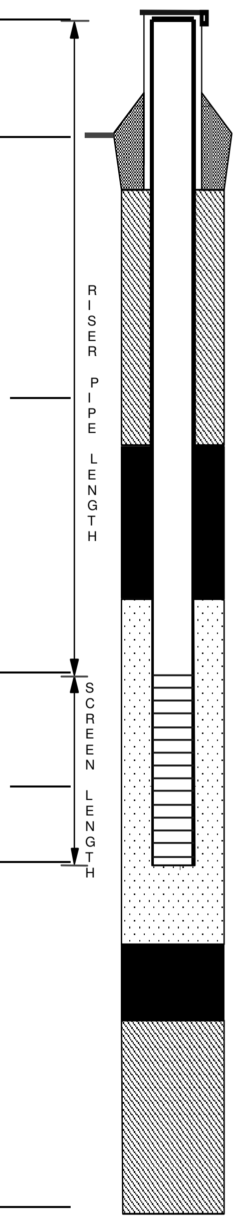
WATER LEVEL DATA FORM

RMT

WELL CONSTRUCTION DIAGRAM

PROJECT:						WELL NO.:	
PROJ. NO:		DATE INSTALLED:		OBSV. BY:		CHECKED BY:	

ELEVATION (BENCHMARK: USGS)	DISTANCE BELOW OR ABOVE GROUND (FT.)



______ **TOP OF CASING**

______ **GROUND**

______ CEMENT SURFACE PLUG

Grout/Backfill Material: ______

Grout/Backfill Method: ______

______ GROUT

Bentonite Seal Material: ______

______ BENTONITE SEAL

______ **TOP OF SCREEN**

Filter Pack Material: ______

______ **BOTTOM OF SCREEN**

______ BOTTOM OF FILTER PACK

______ BENTONITE PLUG

Backfill Material: ______

______ **HOLE BOTTOM**

1. CASING AND SCREEN DETAILS:

A) Type Of Pipe: Pipe Schedule: ____

______

B) Pipe Joints: ______

C) Solvent Used? ______

D) Screen Type: Screen Slot Size: ______

______

E) Borehole Diameter: ____ In. From ____ To ____ Ft.
____ In. From ____ To ____ Ft.

F) Surf. Casing Diameter: ____ In. From ____ To ____ Ft.
2nd Surface Casing: ____ In. From ____ To ____ Ft.

G) Installed Protective Cover W/ Lock? ____

2. WELL DEVELOPMENT:

A) Method: ______

B) Time Spent Developing: ______ Hours

C) Water Removed: ______ Gallons
Added: ______ Gallons

D) Water Clarity Before/After Development:
Before: ______
After: ______

F) Odor (Descr. if present) ______

3. WATER LEVEL SUMMARY:

A) After Developing: ______ Ft. Below Top Of Casing

B) Other Date/Time: ______ Ft.
Other Date/Time: ______ Ft.

Notes: ______

State of Wisconsin
Department of Natural Resources

CHAIN OF CUSTODY RECORD
Form 4100-145 7-87

Sample Collector(s)	Title/Work Station	Telephone No. (include area code)
Property Owner	Property Address	Telephone No. (include area code)

Split Samples: Offered? ☐ Yes ☐ No (Check One)
Accepted? ☐ Yes ☐ No (Check One) Accepted By: ____________________
Signature

Field ID No.	Date	Time	Sample Type		Station Location Sample Description	Lab ID Number	No. of Containers	Comments
			Comp	Grab				

I hereby certify that I received, properly handled, and disposed of these samples as noted below:

Relinquished By (Signature)	Date/Time	Received by: (Signature)
Relinquished By (Signature)	Date/Time	Received by: (Signature)
Relinquished By (Signature)	Date/Time	Received for Laboratory By: (Signature)

Disposition of Unused Portion of Sample:

Dispose ________ Retain for ______ days

Return ________ Other ________

Attachment C
RRD Operational Memorandum No. 2

July 5, 2007

RRD OPERATIONAL MEMORANDUM NO. 2

SUBJECT: SAMPLING AND ANALYSIS - ATTACHMENT 6
SAMPLING METHODS FOR VOLATILE ORGANIC COMPOUNDS IN SOILS

Key definitions for terms used in this document:

NREPA:	**The Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.**
Part 201:	**Part 201, Environmental Remediation, of NREPA.**
Part 211:	**Part 211, Underground Storage Tank Regulations, of NREPA.**
Part 213:	**Part 213, Leaking Underground Storage Tanks, of NREPA.**
MDEQ:	**Michigan Department of Environmental Quality.**
RRD:	**Remediation and Redevelopment Division.**
U.S. EPA:	**United States Environmental Protection Agency.**
Criteria or Criterion:	**Includes the cleanup criteria for Part 201 and the Risk-based Screening Levels as defined in Part 213 and R 299.5706a(4)**
Facility:	**Includes "facility" as defined in Part 201 and "site" as defined in Part 213**
Method 5035A:	**U.S. EPA Method 5035A, "Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples," Test Method for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, United States Environmental Protection Agency, Office of Solid Waste and Emergency Response, Draft Revision 1, July 2002.**
Response Actions:	**Includes "response activities" as defined in Part 201 and "corrective action" as defined in Part 213.**
Sonication:	**The procedure for mixing the soil with methanol using sound waves.**
Purge and Trap	**This refers to the analytical procedure that is commonly used for measuring volatile organic compounds. Chemicals used in this procedure are certified to be uncontaminated with the target compounds analyzed. Methanol certified as such is referred to as "purge and trap" grade methanol.**

PURPOSE

This attachment to RRD Operational Memorandum No. 2 provides direction for the collection and preservation of soil samples using the procedures in U.S. EPA Method 5035A for analysis to determine concentrations of volatile organic compounds (VOCs). This attachment is applicable for site assessments, site investigations, and response activities under Part 201, Part 211, and Part 213.

To produce reliable representative analytical results, the MDEQ implemented the use of the methanol preservation procedures for the preservation of soil samples collected for analysis to determine concentrations of VOCs on April 30, 1998.

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INTRODUCTION

The requirements for collection and preservation of samples are based on the latest revision of U.S. EPA Method 5035A. The applicable contaminants that can be measured are listed within the methods. Other contaminants may be included if method performance data exists for the contaminant that demonstrates the accuracy, precision, and detection that can be measured.

Guidance on applicable target detection limits and available analytical methods are included in RRD Operational Memorandum No. 2, Attachment 1.

USE OF PROCEDURES WITHIN SW-846 METHOD 5035A

The high concentration procedure described in Method 5035A using methanol as a preservative and preserving samples in the field is the preferred method for the collection of soils and analyses of VOCs. Requirements for the acceptance of other methods described in Method 5035A, and requirements for the collection and analyses of soils using the preferred procedure, are provided below.

Method 5035A, Section 8, High Concentration Soils Collected and Preserved in the Field (preferred procedure)

The MDEQ accepts results generated using the methanol preservation procedure described for high concentration soils using Method 5035A for site assessments, site investigations, and response activities provided the requirements listed below are followed and documented:

- Samples are preserved with methanol in the field using a procedure consistent with that provided in Method 5035A. Requirements of the RRD are as follows:
- At least 10 grams of soil are collected.
- The methanol is added immediately in the field after the collection of the sample.
- The methanol must cover the soil. If more methanol needs to be added, it is better to double the amount if ampoules are used to establish the amount of methanol. Otherwise, the amount of methanol added needs to be measured. This will affect the reporting limits. The amount of methanol added must be documented in the field logbook and provided to the laboratory.
- The ratio of methanol volume to soil weight is equal to or greater than 1.
- Samples are sonicated for at least 20 minutes prior to analysis.
- An aliquot of methanol is taken after sonication and stored in VOA vials for analysis.
- The sample with methanol is not used for analysis of volatiles once the aliquot of methanol is taken unless the original aliquot cannot be used.
- Results are reported, corrected for moisture, and miscibility of methanol with water.
- The laboratory standard operating procedures provide the information listed within this attachment's section entitled Laboratory Related Procedures and Documentation.
- Operational Memorandum No. 2, Attachment 1, Target Detection Limits and Designated Analytical Methods direction has been followed.

Method 5035A, Section 8, High Concentration Soil Samples Collected Without a Preservative

The MDEQ does not accept results for VOCs obtained from soil samples collected without preservation to demonstrate compliance to applicable criteria. When the nature of the sample prevents sampling by the acceptable procedures described in this attachment and bulk sampling is the only option that can be used, the results should be evaluated by procedures approved by the RRD. Concentrations of contaminants from samples collected using the bulk sampling procedure should be interpreted as "the minimum concentration of contaminant." When used in this context, the results can be used to demonstrate applicable criteria has been exceeded.

Method 5035A, Section 8, Low Concentration Soil Samples
The MDEQ accepts results generated using the procedure described in Method 5035A for low concentration soil samples for site assessments, site investigations, and response activities, provided the requirements in Method 5035A and those listed below are followed and documented:

- The samples are not exposed to the atmosphere from collection to analyses.
- The sealed containers are attached directly to the instrumentation.
- The preservation is applied correctly to the various soil types.
- Information that validates the use of the method with the appropriate type of soil is provided.

Method 5035A, Use of Soil Coring Devices Used to Transfer Samples to the Laboratory
The MDEQ does not recommend the use of soil coring devices to transport soils to the laboratories when the primary purposes are to identify contaminants of concern or to demonstrate compliance with cleanup criteria. The MDEQ may accept results using the soil coring devices, providing the following requirements are documented:

- Scientific studies exist that demonstrate the device to be effective for the use intended. The manufacturer of the device should be contacted regarding studies that prove them effective.
- The party proposing the use of the soil coring devices must demonstrate the effectiveness of the devices to retain volatile chemicals for the specific chemicals of concern at the facility. Demonstration of the effectiveness of the devices proposed to be used can be accomplished using duplicate sampling. The demonstration must include duplicate samples collected using methanol preservation in the field. Duplicate samples must be collected for a minimum of one sample, or for at least one of every five samples collected.
- Written protocols must be established regarding the use of the devices to collect samples and to preserve samples at the laboratory. These protocols must be provided to the MDEQ.
- Confirmation samples must be collected using methanol preservation in the field equivalent to the standard operating procedure of this attachment. Confirmation samples must be collected for a minimum of two samples, or for at least two from every ten samples collected.
- All requirements of Method 5035A regarding the use of the samplers must have been met.

Method 5035A, Use of Soil Coring Devices Used for Leaching Purposes to Evaluate the Mobility of Volatiles in Soils
The MDEQ requires the use of soil coring devices to evaluate the leaching of volatiles from soils as provided in Operational Memorandum No. 2, Attachment 2, Soil Leaching Methods.

LABORATORY RELATED PROCEDURES AND DOCUMENTATION
The laboratory selected must have written standard operating procedures that address the provision of sampling supplies intended for methanol preservation of samples, sample receipt checks, sample preparation steps and documentation, sample collection requirements, and analyses. The laboratory should first be contacted regarding specific requirements. The following documentation must be included:

- Quality of the methanol used.
- Percent moisture in the samples (determined using separate vial/container with just soil).
- Dates and times samples were collected.
- Dates samples were received at the laboratory.
- Sample weights.
- Actual ratios of methanol to soil.
- Sonication dates/times.
- Minutes of sonication if different from 20 minutes.

Questions concerning this attachment should be directed as follows:

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The following document is rescinded with the issuance of this attachment:
RRD Operational Memorandum No. 2, Sampling and Analysis - Attachment 6, Sampling Methods for Volatile Organic Compounds, Dated October 22, 2004.

APPENDAGE
MDEQ Procedure for Methanol Preservation in the Field.

MDEQ PROCEDURE FOR METHANOL PRESERVATION PROCEDURE

MDEQ LABORATORY SPECIFICATIONS FOR SAMPLE COLLECTION

The following specifications apply for a sample collection kit provided by the MDEQ laboratory. Other laboratories may have similar kits with specifications. Contact the laboratory selected.

Target Soil Weight = 10 grams
Allowed Weight = 9 to 11 grams
Size of VOC Sampling Vials = 40 ml
Plastic bag for sample containers
Methanol Volume (provided in tubes) = 10 ml
Soil Coring Device and Cap = 10 ml
Label

HEALTH AND SAFETY

Material Safety Data Sheets (MSDSs): Provide health and safety data and emergency procedures. The MSDSs should accompany staff in the field. Methanol ampoules, tubes, and vials must be provided to field staff inside protective containers to hold any spillage. Methanol is a toxic and flammable liquid. Handle with proper safety precautions. Wear safety glasses and protective gloves. Nitrile rubber or Viton gloves are recommended. Avoid inhalation. Store and handle in a ventilated area away from sources of ignition and extreme heat. Store the methanol in a cool place, preferably in sample coolers on ice. This is especially important for methanol in tubes where pressure buildup due to extreme heat may result in rupture. Vials should be opened and closed quickly during collection. In the event of eye contact, immediately flush with large amounts of water for at least 15 minutes, occasionally lifting upper and lower lids. Seek medical attention immediately.

SHIPPING

The shipping of methanol may be regulated by the United States Department of Transportation, Title 49 of the Code of Federal Regulations.

APPARATUS AND MATERIALS NEEDED FOR SAMPLE COLLECTION

- Absorbent Material: If the samples are to be shipped by common carrier, vermiculite or similar material should be added sufficiently to completely absorb the methanol for each sample.
- Calibration Weight: Near or equal to the target sample weight.
- Certified Methanol: Methanol certified for purge-and-trap gas chromatography is analytically verified prior to sampling (by lot). In this procedure, the methanol is provided in sealed ampoules. Some laboratories may provide methanol in the sampling vial.
- Field Balance: Capable of holding sampling vial and syringe on the wide mouth jar used to prevent balance contamination and measurement within + 0.2 grams. Note that the procedure in Method 5035A requires a balance capable of measuring to 0.01 grams. The requirement in that document or this attachment can be followed.
- MSDSs: Should accompany sample collection personnel in the field.
- Methanol Sampling Kit/Method 5035A Sampling Kit.
- Protective Wear: Nitrile rubber or Viton gloves. Splash proof safety goggles.
- Plastic Bags: Airtight seals to hold sample VOC vials and sub-coring device.
- Protocol to be Used for the Collection of Samples.
- Sub-Coring Device: A syringe-type device whose material has been tested and found free of contaminants. This device is used to sub-sample the targeted amount of soil for transfer into methanol in the field.

- Wide Mouth Jar (for holding methanol tubes): Of suitable size to allow temporary storage and shipment of the methanol tubes.
- Wide Mouth Jar (for preventing balance contamination): Of suitable size to allow temporary storage of the syringe-type sampler and VOC sample vial on the field balance.
- VOC Vials: Vials with Teflon™ lined septa, pre-weighed, with labels.

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

- Containers: Sample containers are VOC vials with Teflon™ lined septa of suitable size to hold the soil plus methanol, supplied with labels.
- Preservation: Samples are preserved in the field approximately with a one-to-one ratio of soil weight to methanol volume using pre-weighed vials and a field balance. The exact sample weights and ratios are determined at the laboratory. More methanol is added to make the ratio one-to-one when possible. When soil weights are less than the specified minimum or more than the specified amounts of methanol are added, the reporting limits are increased. Specifications for the weight of soils specified by the MDEQ laboratory are provided in the section of this attachment entitled MDEQ Laboratory Specifications for Sample Collection. Samples must be stored and transferred at about four degrees centigrade.
- Holding Times: The maximum allowable holding time is 14 days from sample collection to analysis. If the maximum allowable holding time is exceeded, interpret the results as minimum concentrations of the measured compounds.

METHANOL

Only purge-and-trap grade methanol verified to be suitable for methanol preservation should be used. Field staff should maintain documentation of the methanol lot numbers for all associated samples. If consistently high levels of compounds are measured in methanol field blanks associated with a specific lot number, request the laboratory to verify the quality of the methanol lot used to preserve the samples.

CONTAMINATION

Contamination by airborne VOCs in the air is possible by diffusion through the vial septum during shipment, storage, collection, and analysis. To control such contamination:

- Use appropriate VOC sample vials.
- Avoid sources that generate VOCs such as petroleum products, especially auto exhaust fumes.
- Keep sample containers in coolers as much as possible.
- Collect samples quickly.
- Use methanol provided in sealed ampoules, tubes, or VOC vials.

Attempt to isolate the source of contamination and incorporate appropriate procedures to avoid similar circumstances.

FIELD BALANCE CALIBRATION CHECK

The field balance calibration should be checked as needed and whenever necessary because of handling in the field. Record this check in the field logbook.

MDEQ-RRD FIELD SAMPLING PROCEDURE

1. Make arrangements with the laboratory to obtain appropriate Methanol Preservation Sampling Kits.
2. Record the tracking or lot number(s) for the methanol in the field logbook. If more than one lot is used, each lot must be associated with the samples for which it was used.
3. Prior to collection, check the calibration of the balance. See Field Balance Calibration Check in this attachment. Also estimate the amount of the soil to be collected using the steps in this procedure. The soil used for the estimations must be discarded.
4. Prior to collection, prepare a sufficient quantity of methanol field blanks, i.e., at least one per cooler and one per methanol lot as follows:
5. Select an area free of VOC sources.
6. Remove a methanol tube.
7. Use scissors to cut off the top and place the methanol into one of the pre-weighed sample vials.
8. Place the cap on the vial and tighten it. Avoid over-tightening.
9. Identify it as a methanol field blank.
10. Estimate the amount of soil in the syringe needed to meet the target weight.
11. Place the wide mouth glass jar used to prevent balance contamination on the balance.
12. Record the location, date, and time of sampling in the field logbook. **Do not place any labels, stickers, tape, etc., on the pre-weighed sample vials.**
13. For methanol field blanks, remove the cap from a methanol field blank which was prepared in Step 5 above, place the opened vial in the collection area for the approximate time it takes to collect a sample, then cap the methanol field blank for storage and transport to the laboratory.
14. Place a pre-weighed VOC vial and syringe in the wide mouth jar on the balance.
15. Record the weight in the field logbook. If the balance features re-zeroing, zero the balance.
16. Remove the syringe. If a cap is provided, remove the cap and place it in the jar.
17. Insert the open end of the syringe into a fresh face of undisturbed soil and fill it as appropriate according to the amount of soil needed (Step 6).
18. If necessary, use your gloved finger (decontaminate before next sample) or other appropriate instrument and push the soil deeper into the syringe sampler.
19. If a cap was provided, immediately cap the end of the syringe.
20. Place the syringe in the jar on the balance. Read the weight, and if necessary, subtract the weight of the syringe, vial, and jar, as appropriate to determine the weight of the soil.
21. If the weight of the sample is determined to be more than the maximum amount allowed, extrude enough soil to obtain the target amount within the specified tolerance and re-weigh.
22. If the weight of the sample is less than the minimum amount allowed, re-sample and repeat steps starting with Step 7.
23. Record the soil weight in the field logbook. DO NOT RECORD the weight on the sample vial label.
24. Remove the cap from the sample vial and place it in the jar on the balance with the septum upwards.
25. If the required amount of methanol is not included with the pre-weighed vial, immediately remove a methanol tube from the wide mouth glass storage jar. Holding the tube upright, use scissors to cut (plastic) off one end and pour the methanol into the sample vial, taking care to avoid spillage.

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26. Insert the open end of the syringe sampler into the mouth of the vial and carefully extrude the soil, taking care to avoid spillage. Loss of several drops will not make a significant difference in the results. If a significant amount is spilled, a new sample must be collected or the sample must be appropriately flagged to indicate estimated results.
27. Using a clean brush, paper towel, or other suitable material, thoroughly wipe excess soil particles from the threads and vial body. Particles left on the threads will prevent a good seal.
28. Place the VOC cap on the sample vial. The cap must be tight; however, over-tightening should be avoided.
29. Gently swirl the sample and methanol for about 10 seconds to break up the soil. DO NOT SHAKE.
30. Place the sample in a plastic bag on ice in a cooler.
31. Using the syringe sampler, take another sample from the soil.
32. Cap and label the syringe with the sample identification.
33. Place the syringe with the sample in the plastic bag. This sample is for dry weight determination.
34. Decontaminate the jar/balance using decontamination procedures appropriate for the type and level of contamination.
35. Unused methanol must be returned to the laboratory for disposal.

CHANGES FROM PREVIOUS GUIDANCE

1. Some language was changed to clarify the meanings.
2. The requirement to sonicate as soon as possible upon receipt at the lab was removed as the phrase "as soon as possible" was not clear.
3. Requirements for implementing the methanol preservation procedure was changed to ensure the methanol covers the soil and results would be corrected based on the soil's moisture content and the miscibility of the methanol with the soil water.

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